# Beach Processes on the Oregon Coast

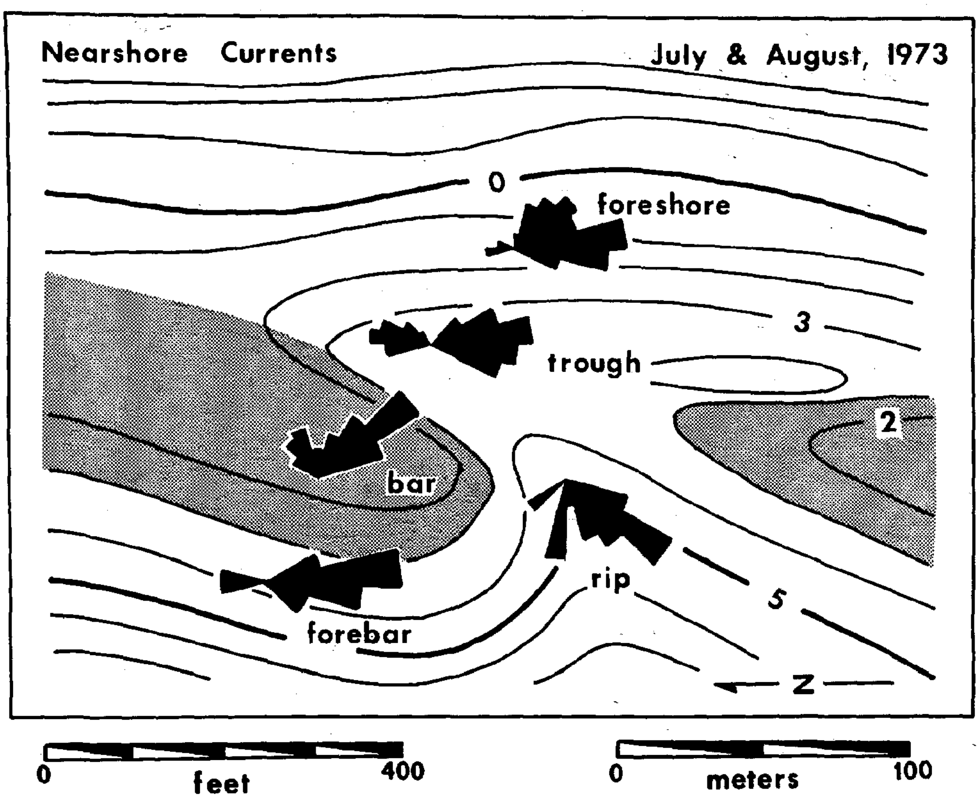
## July, 1973

by



WILLIAM T. FOX, Williams College

RICHARD A. DAVIS, JR., UNIVERSITY OF SOUTH FLORIDA




A TECHNICAL REPORT UNDER THE
OFFICE OF NAVAL RESEARCH
REPORT NUMBER 12
CONTRACT NONR-388-092
WILLIAMS COLLEGE

03490



# BEACH PROCESSES ON THE OREGON COAST, JULY, 1973



by

William T. Fox

and

Richard A. Davis, Jr.

Technical Report No. 12, August 30, 1974

of

ONR Task No. 388-092/10-18-68(414)

Contract N00014-69-C-0151

Office of Naval Research

Geography Branch

Williams College

Williamstown, Massachusetts

This report has been made possible through support and sponsorship by the United States Department of the Navy, Office of Naval Research, under ONR Task Number 388-092, Contract N00014-69-C-0151. 

## FORWARD

This report is the twelfth in a series of technical reports by W. T. Fox and R. A. Davis, Jr. based on detailed beach and nearshore studies. The ultimate goal of the long term project is to learn enough about processes and responses in different coastal environments so that reasonable predictions can be made about changes which take place in the nearshore environment. The final aim is a computer simulation model with weather data as input and beach maps as output.

The first eight technical reports covered various aspects of data collection and analysis as well as conceptual and computer models for the eastern shore of Lake Michigan. The ninth technical report covered Mustang Island, Texas, the tenth was on Sheboygan, Wisconsin and the eleventh on Cedar Island, Virginia. The present report is based on a 45-day study on the central Oregon coast during the summer of 1973. The coastal orientation is similar to the eastern shore of Lake Michigan, but large tidal range, high waves and broad intertidal zone provide significant contrasts.

## ABSTRACT

During July and August, 1973, a 45-day time-series study was undertaken on the central Oregon coast to relate weather and wave conditions to beach erosion and sand bar migration. The summer weather pattern was dominated by the East-Pacific subtropical high which produced winds and waves from the northwest and extended periods of upwelling and coastal fog. When low pressure systems moved through, wind and waves shifted to the southwest. Waves were 1 to 3 meters high with periods of 5 to 9 seconds. Rip currents and southward flowing longshore currents reached 90 centimeters/second in the surf zone. Tide range was 2 to 4 meters.

Three beaches were mapped at low tide to show changes in beach and bar morphology through time. At South Beach, Oregon two sets of bars with intervening rip channels advanced shoreward at 1 to 5 meters/day and southward at 10 to 15 meters/day. At Beverly Beach, Oregon, a basalt ridge 700 meters offshore resulted in wave diffraction and sand deposition in the central portion of the beach. A rip channel at the south end of the beach moved 300 meters to the south. At Gleneden Beach, cusps 40 meters long were cut into the steep foreshore. A rhythmic topography with bars and rip channels existed in the nearshore. Sand bars advanced across the rip channels at 5 meters/day and welded onto the base of the foreshore.

## ACKNOWLEDGEMENTS

The support and cooperation of the Office of Naval Research is gratefully acknowledged.

Student field assistants Dave Lehman, Dave McTigue and Erik Thorp of Williams College rose with the sun for pre-dawn beach profiles.

The School of Oceanography at Oregon State University assisted in several aspects of the project. Paul Komar arranged for sabbatical leave for W. T. Fox at O.S.U. and joined in many helpful discussions concerning methods and results. Clayton Creech and Dave Zoph made available the wind and wave data at the O.S.U. Marine Science Center at Newport, Oregon. Marty Miller and Cary Rea helped profile during the fall and winter storms.

Special thanks go to Cynthia Howard for typing and proofreading the manuscript.

TABLE OF CONTENTS

# BEACH PROCESSES ON THE OREGON COAST, JULY, 1973

## INTRODUCTION

Broad sand beaches and rugged volcanic headlands characterize the spectacularly beautiful Oregon coast. In the summer, a series of low sand bars and rip channels are active at high tide and exposed at low tide. At high tide, the waves and currents shift the sand, forming new bars and destroying old ones. Fall and winter storms with waves up to 10 meters high strip a large portion of sand from the beaches forming offshore bars and leaving rock terraces exposed in many places. With the return of spring and summer, the sand bars move onshore replenishing the beach.

During the summer, the waves are generally 1 to 3 meters high and the coast is often shrouded in fog. North winds blowing along the shore cause frequent upwelling of deep, cold water giving rise to the coastal fog. Although the water is usually too cold to be enjoyed by swimmers, agate hunters and driftwood collectors frequently roam the beaches.

Large estuaries on major rivers and coastal streams reduce the supply of sand to the beaches. In an attempt to preserve coastal properties, sea walls are often placed along the base of a cliff or groins set normal to the beach to stop erosion. A more reasonable solution to beach erosion is to understand the processes involved and to live with the sea instead of trying to conquer it.

To expand our understanding of coastal processes and beach erosion, two time series studies were undertaken along the Oregon Coast. During the summer of 1973, a short term study (6 weeks) was completed and a long term study (1 year) was initiated. For the short term study, weather and wave conditions at Newport, Oregon were recorded at 1 hour intervals and 3 beaches were surveyed once every 3 days. In this study, it was possible to correlate significant changes in beach topography with wave activity at different times in the tidal cycle. In the summer, the waves are relatively small and rapid changes take place in the beach and intertidal bar configuration. For the year long study, weather and wave conditions were monitored 4 times each day and the beach was surveyed once every two weeks at low spring tide. Steady rains, high winds and large waves make the working conditions on the beach difficult and dangerous during the winter.

## Study Area

The central Oregon coast consists of a series of volcanic headlands separated by broad beaches covering wave-cut terraces (Figure 1). The volcanic headlands are formed by ring dikes, sills and basalt flows which form cliffs, arches and sea-stacks. Tertiary sedimentary rocks ranging from conglomerates to siltstones make up the bedrock of the area. During the Pleistocene, wave-cut surfaces were formed in the tertiary bedrock when the sea was higher in an interglacial stage (Figure 2). A pebble conglomerate is usually present at the base of the terrace deposits and is overlain by up to 3 meters of beach and dune sediments.

A broad wave-cut terrace has been cut into the tertiary bedrock and forms a platform for the present day beach (Figure 2). In the summer, the wave-cut terrace is covered with a thin veneer of sand from 1 to 3 meters thick. Intertidal sand bars advance across the beach during quiet wave conditions. During the late fall and winter storms, much of the sand is stripped from the beaches, and large sand bars are formed below the low tide level. In the spring and summer, the bars move onshore and replenish the sand lost during the winter storms.

Maps of the beach and nearshore topography were made at 3 day intervals to study the effects of waves and currents on the beach and bar configuration. The primary study site was located on a wide, flat beach at South Beach, Oregon about 3 kilometers (2 miles) south of the jetty at Newport (Figure 1). A second site was located at Beverly Beach about 12 kilometers (7 miles) north of the Newport jetty. At Beverly Beach, a rock ledge is exposed about 750 meters (2400 feet) offshore and resulted in a protuberance on the beach behind the ledge. The third site was located at Gleneden Beach at the south end of Siletz Spit and 35 kilometers (21 miles) north of the Newport jetty. The beach at Gleneden has a well developed berm with prominent cusps cut into a steep foreshore. Observations were also made at Ona State Park about 16 kilometers (10 miles) south of the Newport jetty where Beaver Creek enters the Pacific Ocean. A map was also made of Greys Harbor Beach, Washington, where a large ridge and runnel system was formed on the beach.

## Environmental Setting

The central Oregon coast runs in a north-south direction and is fully exposed to the waves from the north and south Pacific. During the summer, the East Pacific sub-

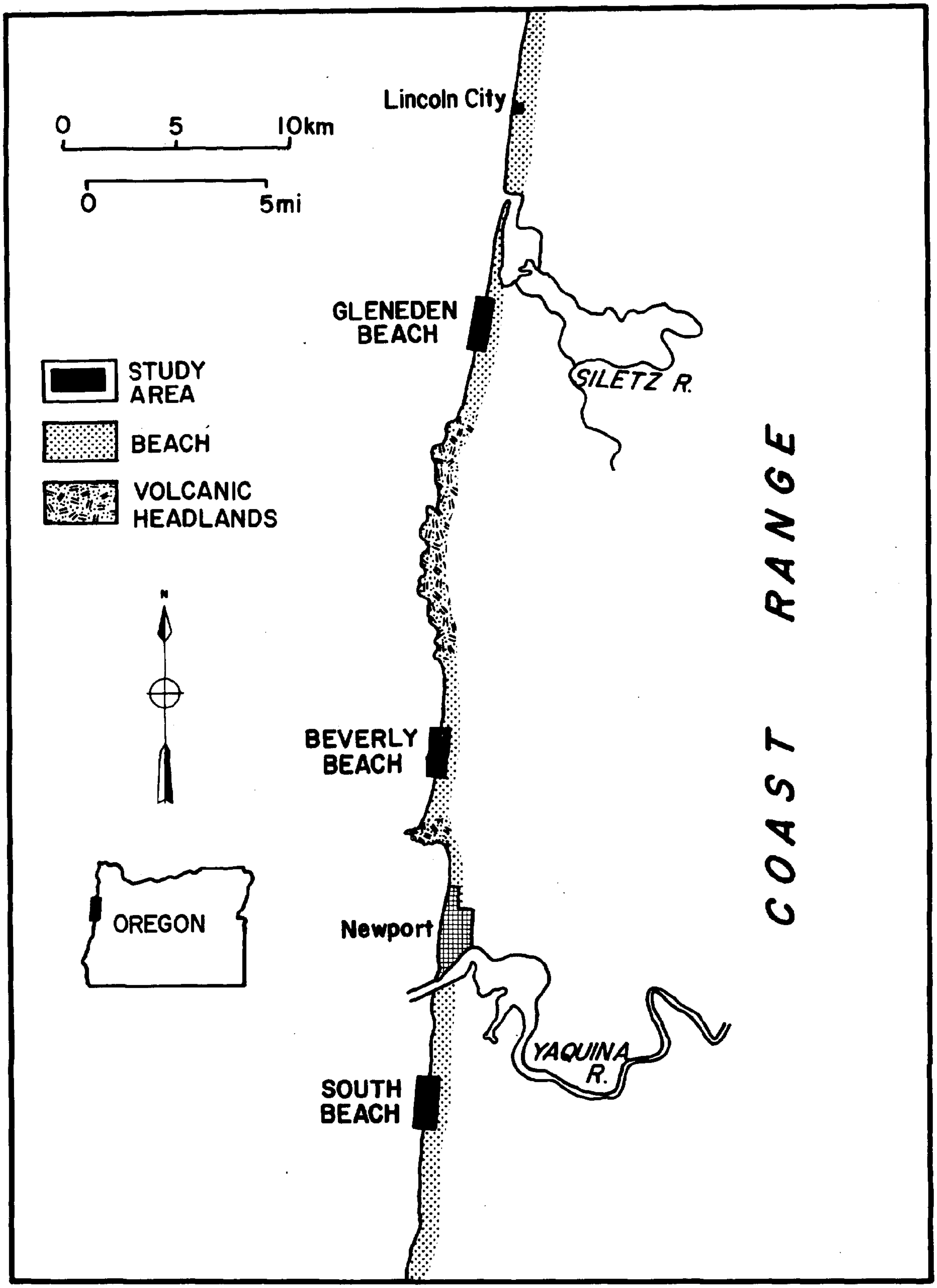



Figure 1. Location map of 1973 study sites at Gleneden Beach, Beverly Beach and South Beach, Oregon.

tropical high builds up off the Oregon coast. The clockwise air flow around the high channels winds from the north along the coast. The north winds produce almost constant upwelling which is often accompanied by coastal fog. When low pressure systems move through the area, the wind shifts briefly to the southwest and the upwelling is interrupted for a short time.

During the summer months, the waves are generally locally generated and are related to the passage of low pressure systems. The waves which are 1 to 3 meters high approach the shore generally from the northwest. At low tide, a southward flowing longshore current is formed on the seaward edge of the sand bars. At mid-tide, the local topography of the sand bars influences the longshore current and rip currents are generated at low points between the bars. At high tide, the sand bars are submerged and the longshore current once again moves to the south, but along the upper beach. When low pressure systems pass over, the waves shift to the southwest and the longshore currents move to the north along the beach.

Tides have a strong influence on coastal processes along the Oregon coast. A mixed diurnal-semidiurnal tide with a spring tide range of 4.8 meters and a neap tide range of 2.0 meters is present on the beaches. At spring tides, the influence of waves is spread across the entire beach, while at neap tides, it is restricted to the central portion.

## Previous Studies

Time series studies on the beach environment have been conducted at Virginia Beach, Virginia by Harrison and Krumbein (1964), Harrison *et al.*, (1968) and Harrison (1969). A group from the Coastal Studies Institute at Louisiana State University including Dolan, Ferm and McArthur (1969), Sonu and Russell (1966) and Sonu, McCloy and McArthur (1966) carried out similar studies on the outer banks of North Carolina. A model was developed to account for the cycles observed in beach profiles (Sonu and Bech, 1971) which was later expanded into a Markov model of beach cycles (Sonu and James, 1973). Studies have also been conducted along the beach at Eglin Air Force Base near Fort Walton Beach, Florida (Sonu, 1972). The techniques in the present study were applied to the ridge and runnel topography on Plum Island, Massachusetts by Abele (1973).

The present report is part of a continuing series of studies by Fox and Davis to develop a generalized computer simulation model of coastal processes. During the

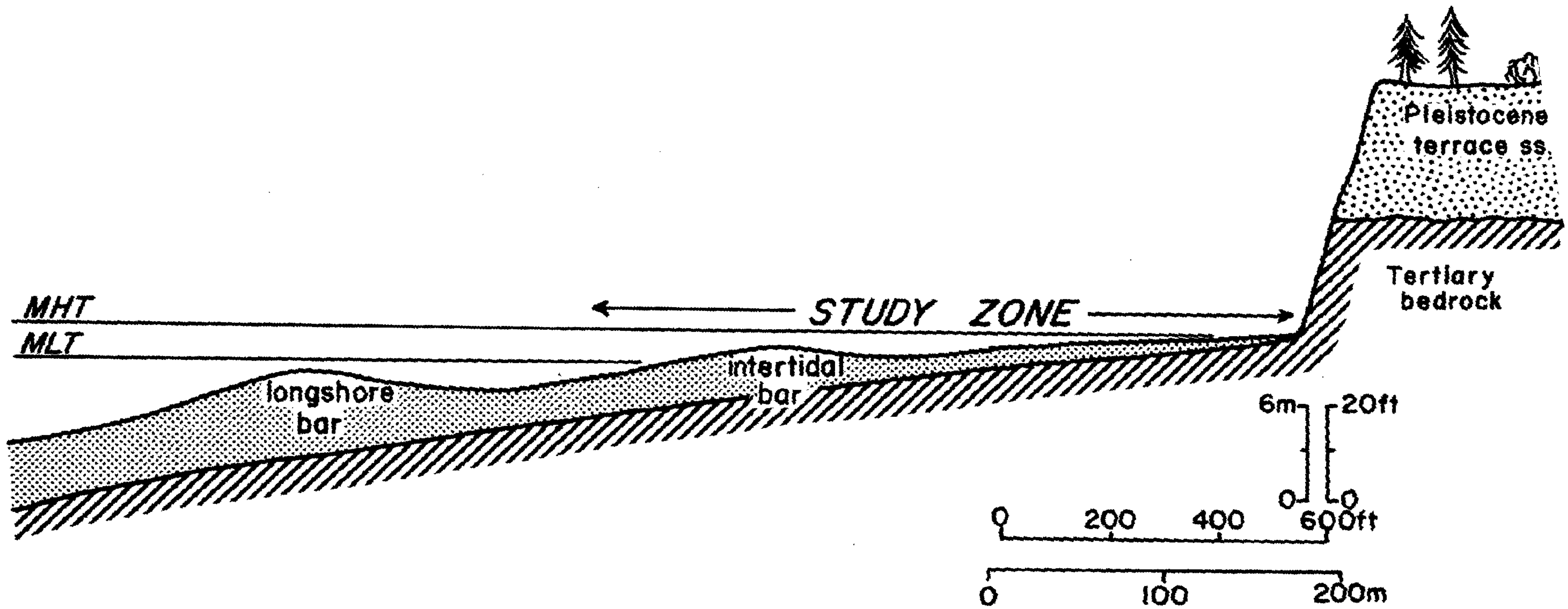



Figure 2. Generalized profile across the cliff and wave-cut terrace at South Beach, Oregon.

summers of 1969 and 1970, data were collected at Stevensville, and Holland, Michigan (Fox and Davis, 1970 and 1971a) to construct a computer simulation model (Fox and Davis, 1971b and 1973a). Field studies were undertaken on the coast of Texas (Davis and Fox, 1972) and the west coast of Lake Michigan near Sheboygan, Wisconsin (Fox and Davis, 1973b). During the summer of 1973, field studies were completed on the Delmarva Peninsula in Virginia and on the Oregon coast, where tides and ocean swells have a great influence.

## FIELD OBSERVATIONS

During the summer of 1973, field observations were made of weather conditions and coastal processes along the central Oregon coast for 45 days from July 1 through August 14, 1973. Hourly readings for barometric pressure, wind speed and direction, air temperature, humidity and tide level were taken from continuously recording instruments at the U.S. Weather Station located in the Oregon State University Marine Science Center at Newport, Oregon. Wave period and height were derived from microseismograph records at the Marine Science Center. Direct wave observations including breaker height, period and angle were made twice each day at 0800 and 2000 in the surf at the South Beach study site. When the survey crew was not at another beach site, wave observations were also made on South Beach at 1400. Along with each set of wave measurements, the speed and direction of the littoral current were recorded at South Beach. The littoral current was measured at three locations along the beach to include the effect of rip currents. The rip currents were strongly influenced by local beach topography and change position each day with rising and falling tides. The observed data is given in Appendix A.

### Barometric Pressure and Weather

During the summer months, the weather pattern on the Oregon coast is dominated by the East Pacific subtropical high. The high, which is often situated a few hundred kilometers off the coast, influences the flow of wind and weather patterns along the shore. The plots of observed and filtered curves for barometric pressure show several weak lows which moved across the area (Figure 3a). The low points on the barometric pressure curves represent fronts which moved in from the Pacific or up from California. The major frontal systems which had an effect on the local winds and waves passed over the coast on July 5 through 7, and August 6, 1973 (Figure 3a). The barometric pressure ranged from a low of 1013.2 millibars on July 16 to a high of 1026.2 on July 11.

During the 45 days of observation, the air temperature varied from a low of 7°C (45°f) to a high of 22°C (72°f) (Figure 3b). The air temperatures are affected by fog or cloud cover and wind conditions. The lowest temperature was recorded during the early morning hours of July 1 and 2, when the sky was very clear and still. As a high pressure system moved into the area, the air temperature rose. When a low moved in on July 7, the night temperature dropped to the low fifties while the day temperatures reached in the low sixties. From July 8 through 16, the range in daily temperatures increased to lows in the mid-forties and highs in the upper sixties. On July 17, a fog bank built up along the shore due to coastal upwelling accompanying strong north winds. During the upwelling, the water temperature dropped from 14.4°C to 6.6°C (58°f to 44°f) within two days. The coastal fog developed from the contrast in air and water temperature. During breaks in the fog from July 25 through 30, the diurnal temperature range increased. The highest temperature, 22.2°C (72°f) occurred on the afternoon of July 27. When the fog returned, the afternoon high settled down to the mid-sixties, more normal for a summer day on the Oregon coast.

## Wind Speed and Direction

Data for wind speed and direction were obtained from an anemometer located at South Beach, Oregon on the south bank of the Yaquina River across from the town of Newport. Wind speed and direction were measured with a 3-cup anemometer and twin-tail vane placed at the back of the beach on top of the winter berm. The sensor is about 20 meters above mean sea level and 9 meters above the ground, approximately 100 meters east of high water on the beach. North of the jetties and south of the site, wide sand beaches extend for several kilometers in an approximately north-south direction. High bluffs occur behind the beach to the north whereas lower bluffs are found to the south. The sensors are located such that a due-north wind is almost parallel to the shore and has an overwater trajectory. Signals from the anemometer are transmitted on an underground cable to the Oregon State University Marine Science Center, where they are recorded on an Esterline Argus chart recorder. Readings for this study were taken from the chart recorder at 1 hour intervals for 45 days giving a total of 1080 observations.

During July and August, the surface winds on the Oregon coast are dominated by the eastern Pacific subtropical high (Frye, Pond and Elliot, 1972). This high generally produced strong north-to-northwest surface winds, which in turn produce intense coastal upwelling. A diurnal variation in wind speed due to an apparent sea breeze effect is superimposed on the northerly flow. When a low pressure trough moves across the coast, the wind shifts over to the southwest for a short period of time before returning to the dominant north-northwest flow.

The wind speed reached a maximum of 15 meters/

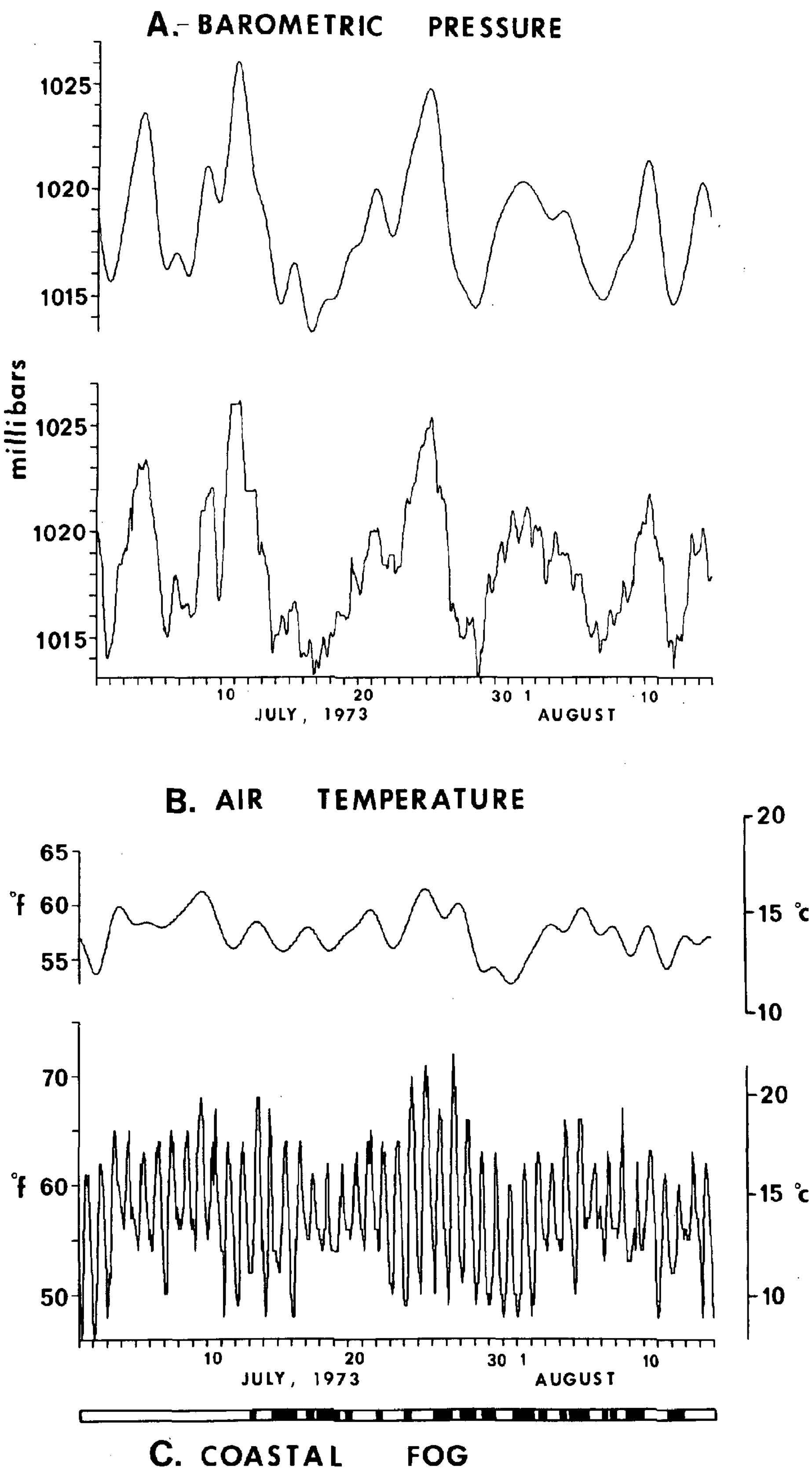



Figure 3. Smoothed and observed curves for (A) barometric pressure and (B) air temperature, and (C) bar graph for coastal fog at Newport, Oregon.

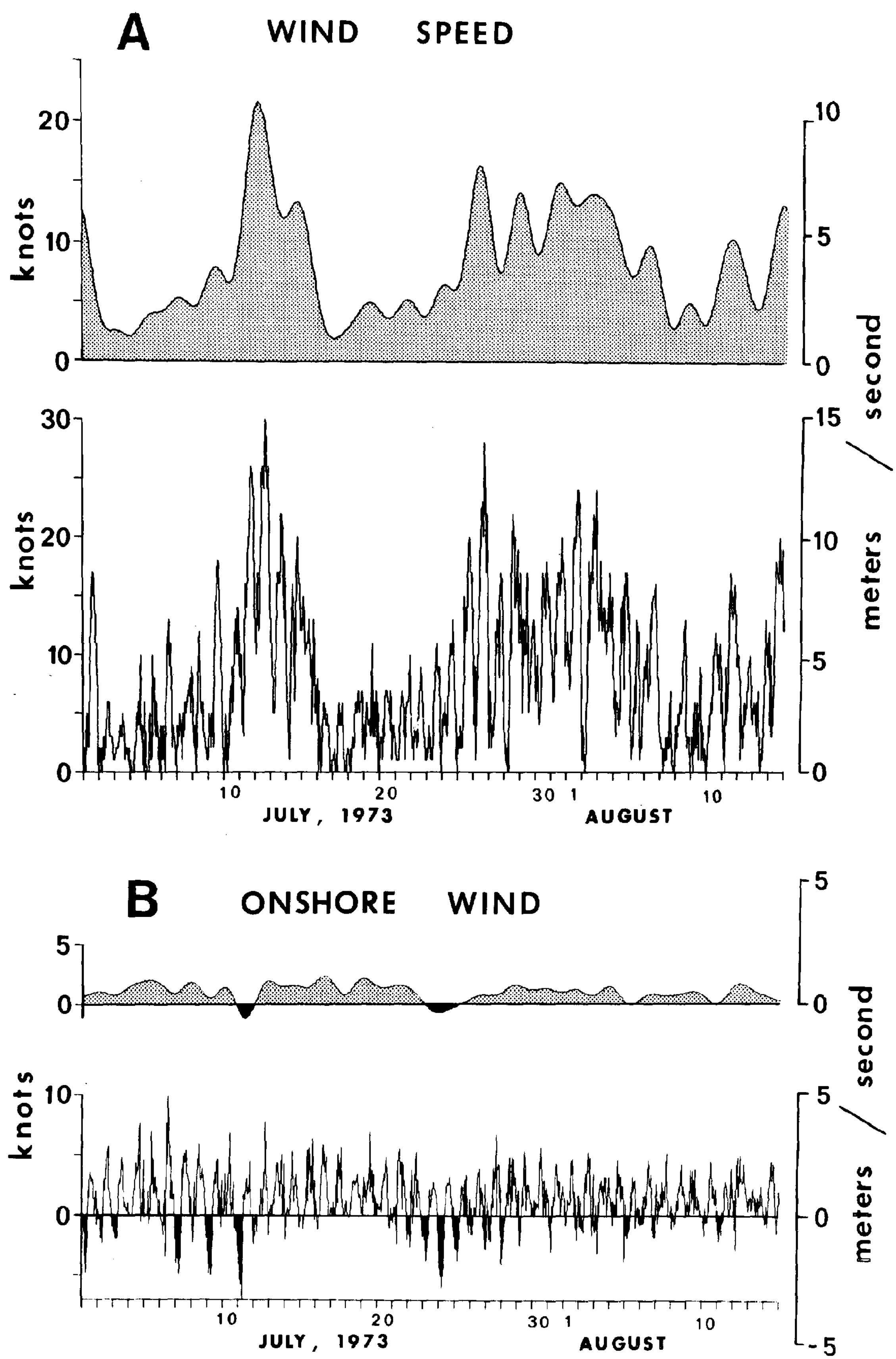
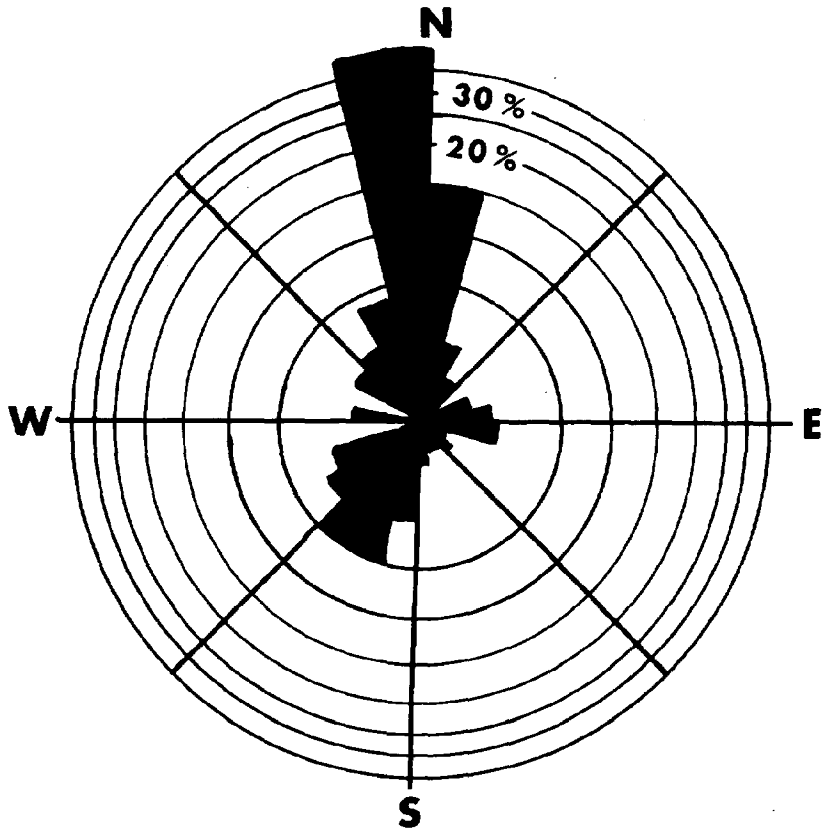



Figure 4. Smoothed and observed curves for (A) wind speed and (B) onshore component of the wind at Newport, Oregon.

A.

Wind Direction




B.

Nearshore Currents

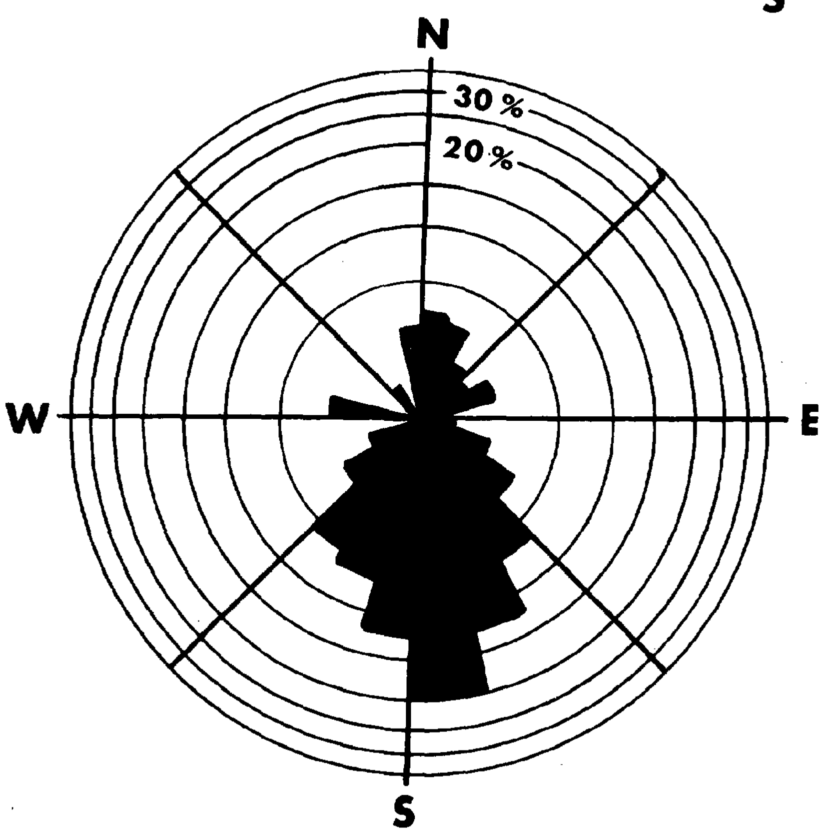



Figure 5. (A) Wind and (B) current rose diagrams for July 1 through August 15, 1973 at Newport, Oregon.

second (30 knots) at 1700 on 12 July 1973 (Figure 4a). The mean wind speed for the 45 days was 4 meters/second with the highest velocities recorded on 12 and 25 July. The high wind velocities resulted from circulation around high pressure areas located a few hundred miles off the Oregon coast. The diurnal nature of the wind can be seen in the observed curve for July and August (Figure 4).

A wind rose was plotted for the wind data from 1 July through 14 August 1973 (Figure 5a). The shoreline is oriented north-south with the Pacific Ocean to the west. The wind blew within 15° on either side of north (345° to 15°) for 52.3 percent of the time, and 30° either side of north (330° to 30°) for 59.5 percent of the time. The wind blew out of the east (75° to 105°) for 4.5 percent of the time and out of the southwest (180° to 255°) for 21 percent. The onshore-offshore winds are the result of the sea breeze effect which is often dominated by strong north or southwest winds. The southwest winds occur when warm fronts move through the area causing a counterclockwise flow around the low pressure center.

The onshore and longshore components are plotted to show the effect of wind direction as well as wind speed (Figures 4b and 6). To compute the longshore component of the wind, the observed wind speed (Figure 4a) was multiplied by the cosine of the wind direction. Therefore, a north wind is positive and a south wind is negative. To compute the onshore wind component, the wind speed was multiplied by the negative sine of the wind direction. An onshore wind from the west would be positive and an offshore wind from the east would be negative.

The longshore component of the wind (Figure 6) blows out of the north most of the time as shown in the wind rose (Figure 5a). On July 1, a high dominated the weather pattern with winds about 12.5 meters/second out of the north. From 2 July through 8 July, a weak front stalled offshore with the southwest winds reaching 6 meters/second on 8 July. From 9 July through 15 July, north winds swept along the shore. On 10 July, the longshore component of the wind reached almost 15 meters/second.

From 16 through 21 July, a low pressure system moved up from California and displaced the eastern Pacific subtropical high producing winds of 3 to 4 meters/second from the south and southwest. The longest continuous period of north winds occurred for 18 days between 22 July and 8 August 1973. A weak low which attempted to move up from California on 28 July, decreased the north component of the wind, but did not displace the subtropical high.

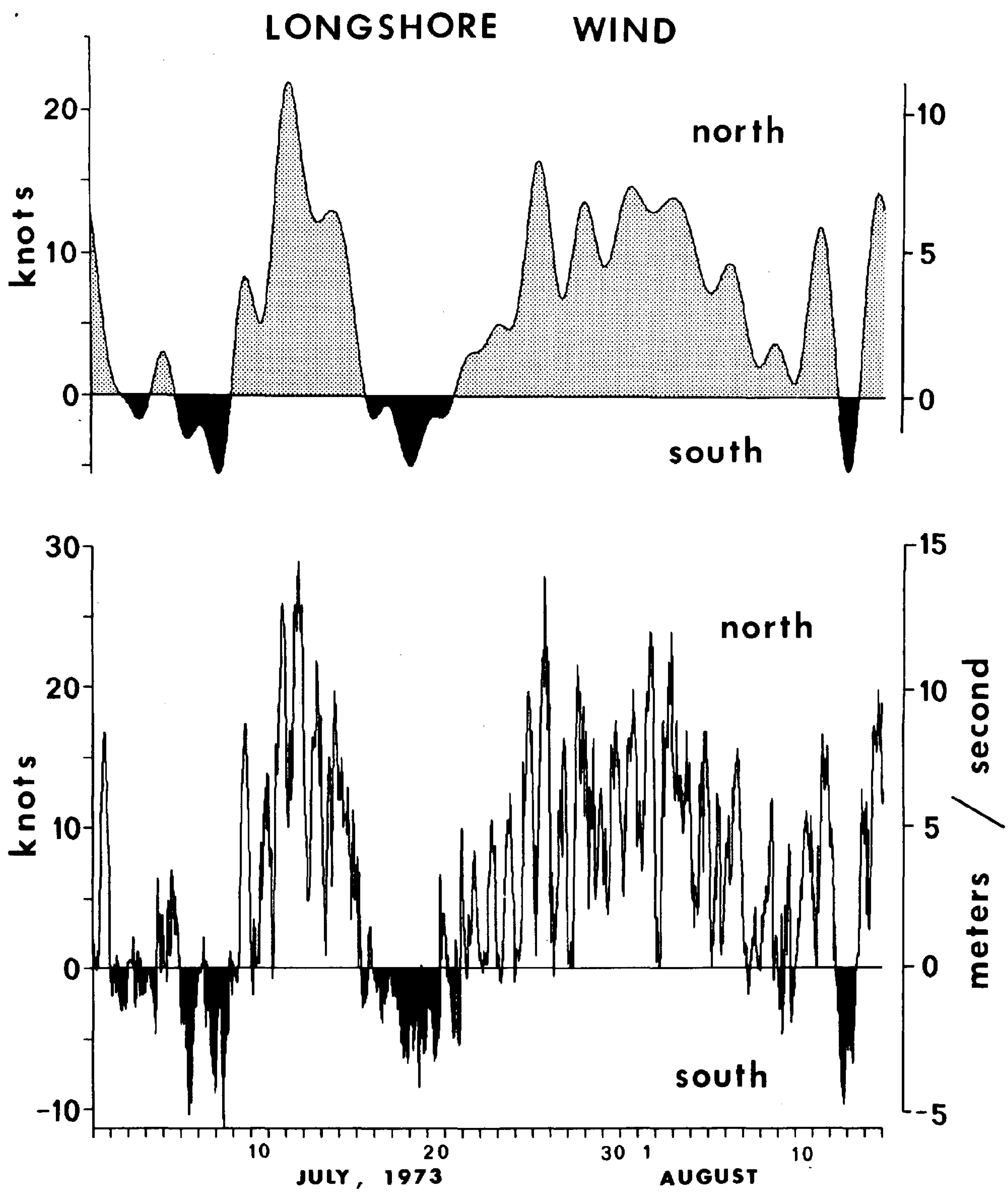



Figure 6. Smoothed and observed curves for longshore component of the wind at Newport, Oregon.

Fronts moved across the coast from the north Pacific on 9 and 13 August resulting in weak southwest winds on the 9th and stronger south winds at 5 meters/second on 12 and 13 August.

The longshore winds show a definite diurnal component increasing in the afternoon and dropping off at night. The sea-breeze pattern is deflected along the coast by the large difference in land and water temperature.

The onshore component of the wind shows a fairly regular pattern (Figure 4b) reaching a maximum onshore wind of 5 meters/second in the afternoon with 1.5 to 2.5 meter/second breeze at night. On 11 and 24 July, the offshore component reached 2.5 to 4 meters/second. The highest offshore component accompanied the strongest winds out of the north which did not completely die out at night. Normally, one would expect a sea and land-breeze to show a 12 hour pattern with the onshore breeze increasing in the afternoon and the offshore breeze picking up in the evening. However, along the northwest Pacific Coast of the United States, the diurnal wind field is superimposed on the subtropical high and the result is a strong 24 hour rather than 12 hour periodicity in the wind speed (Frye, Pond and Elliott, 1972, p. 673). The cold surface waters dropping to 7°C during upwelling would tend to inhibit the development of a land breeze at night.

## Wave Characteristics

Ocean wave periods and heights were derived from seismograph records at the Marine Science Center. The seismograph was operated by Mr. Clayton Creech under the direction of Dr. David Zopf of the School of Oceanography, Oregon State University. The following information concerning the seismic records was obtained from Creech and Zopf (Creech, 1973).

Theory developed by Longuet-Higgins (1950) predicts that a standing wave will result from the interference of incident and reflected waves on a sloping beach. The standing waves produce a pressure field on the ocean bottom which will generate seismic waves propagating in a horizontal plane. The amplitude of the seismic motion is linearly related to the pressure field and has twice the frequency of the incoming ocean waves. The amplitude on the seismograph is related to wave height by equation 1:

$$H_0 = \frac{r \cdot P^3}{K} \qquad (1)$$

where H is the deep water wave height, r is the peak-to-peak deflection on the recorder chart, P is the seismic wave period and K is an empirically derived constant. Based on this theory, a long-period vertical seismometer was installed at the Marine Science Center in May 1971. The seismometer rests directly on a concrete pad which forms the floor of the center building. The building is on 45 feet of unconsolidated sediment and fill overlying basalt bedrock. The sediment layer extends 1.5 miles across the beach and intertidal zone.

The seismometer is a portable commercial unit (Teledyre-Geotech Mod. SL-210) designed for geophysical surveys. It has an adjustable natural period of 10-30 seconds and has been automatically programmed to produce 12 minute records at 6 hour intervals. Readings from the seismometer were calibrated using visual observations from the shore, a pressure transducer on the ocean bottom, and a Ross Fine-line fathometer. There is a good correlation between the wave heights and periods derived from the seismometer and the observed and measured heights and periods (Creech, 1973).

Significant wave height is the average wave height for the upper one-third of the waves based on the seismograph records (Figure 7a). During the 45 day study, the significant wave height varied from a minimum of 0.66 meter (1.2 feet) on July 2 to a maximum of 2.0 meters (6.5 feet) on July 16. The mean significant wave height was 0.85 meters. The plot of significant wave height shows a general increase for the first 16 days, then a period of low waves for the remainder of the study with small peaks of about 1.2 meters on July 26 and August 8, 1973. The curve for breaker height was derived from the significant wave height and therefore, closely resembles the significant wave height, but is 1.28 times as high (Figure 7b). Several of the peaks in the breaker height curve are aligned with the low points in the barometric pressure curves (Figure 8).

There is no apparent close correspondence between the wave height curves and the curves for wind speed (Figures 4 and 7). The first major peak in the wind speed curve occurs on July 13 as the barometric pressure was falling. The wind was blowing strongly out of the north parallel to the shore and wave heights reached about 1.8 meters. From July 13 to July 16, the wind speed dropped from 15 to 3 meters/second, but the wave heights increased to 2.0 meters. From July 16 through 21, the winds blew out of the southwest at about 3 meters/second and the wave heights dropped off to about 0.6 meters. Waves on the 16th were fairly long period swells. The small spike on the wave record for July 26 may have resulted from the 14 meters/

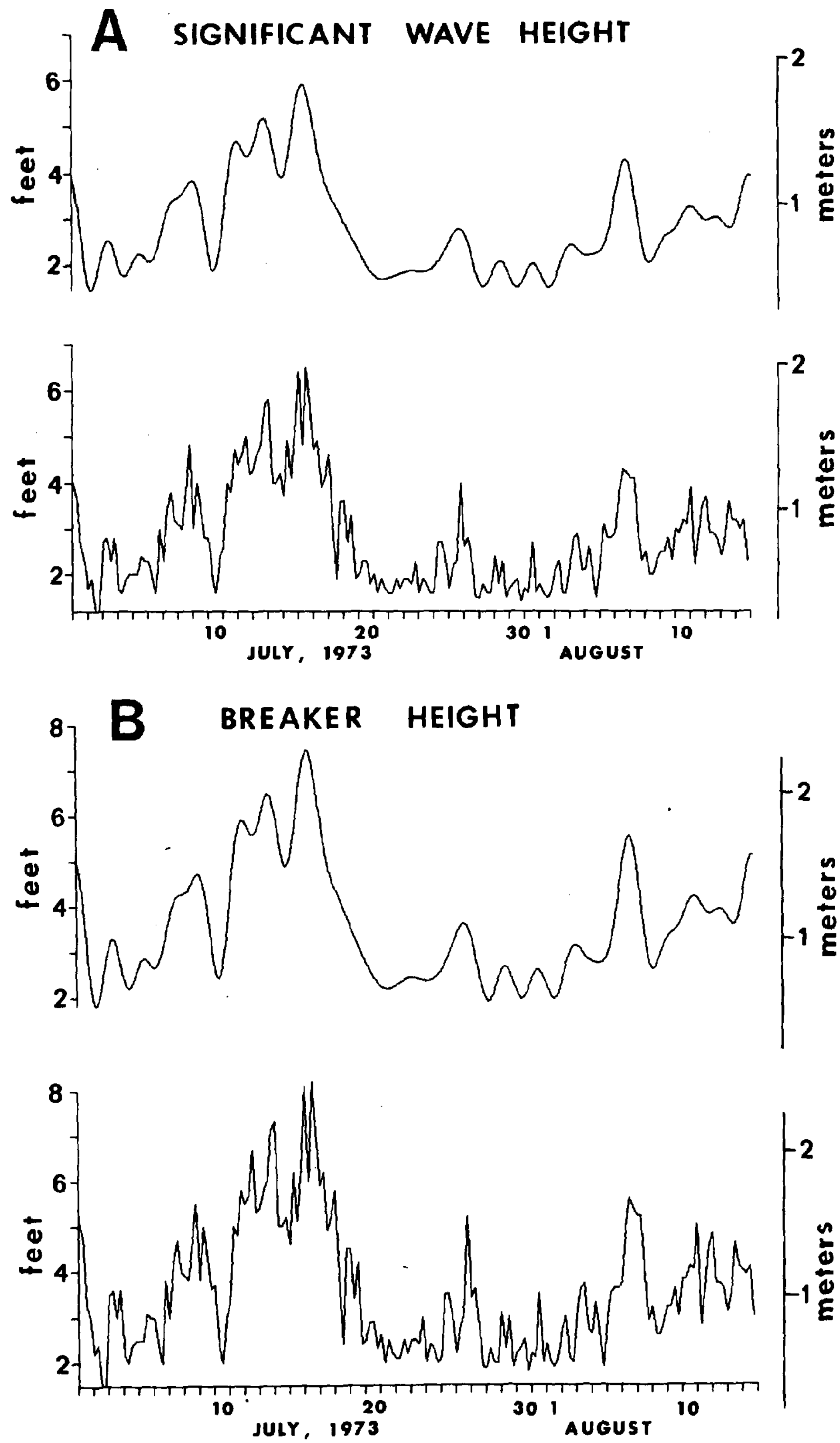



Figure 7. Smoothed and observed curves for (A) significant wave height and (B) breaker height at Newport, Oregon.

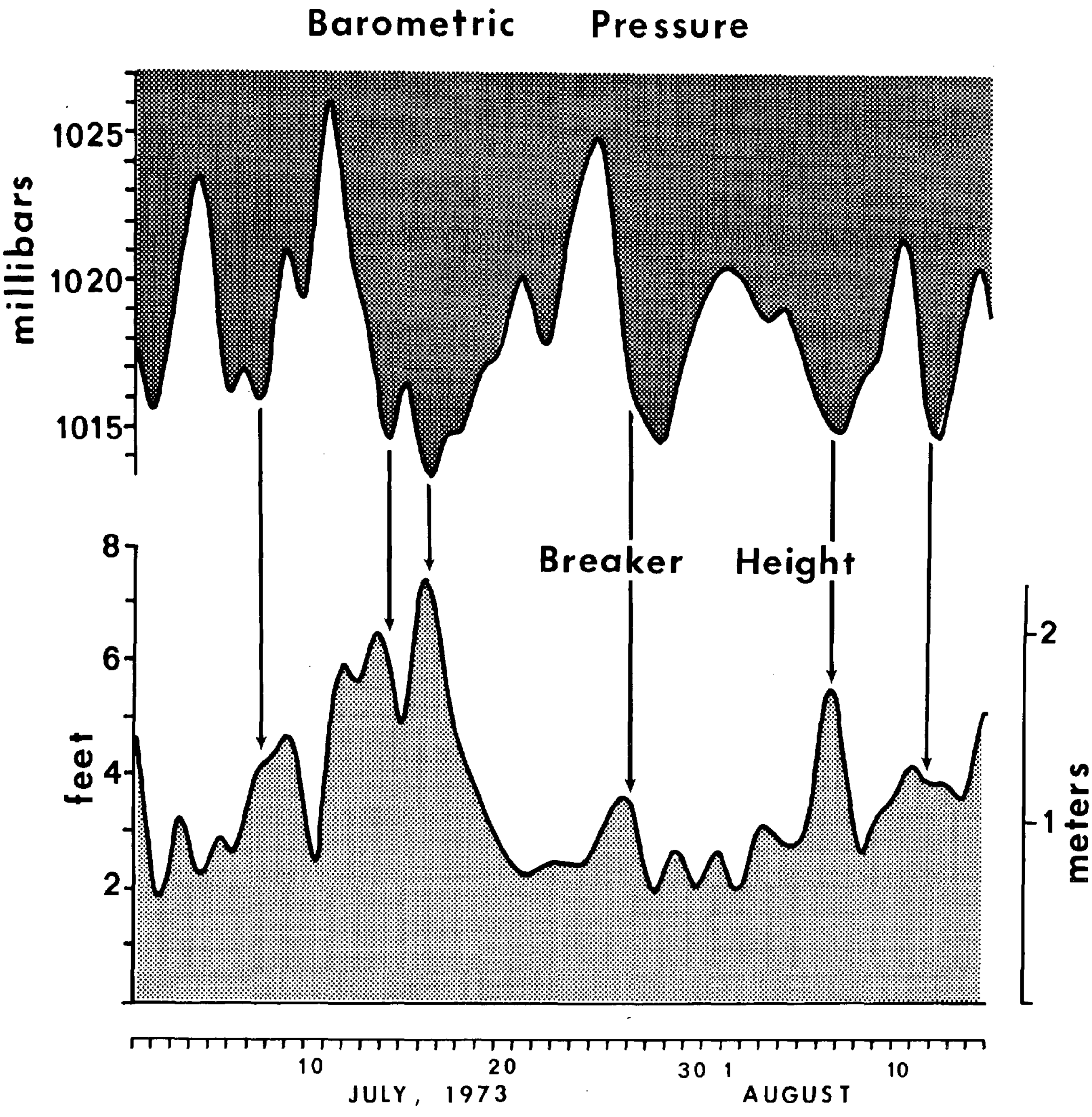



Figure 8. Smoothed curves showing alignment of lows in barometric pressure with peaks in the breaker height curve.

second winds which blew along the shore. The next period of high waves occurred on August 6 and is again related to a drop in the local wind speed. Toward the end of the study, the waves picked up again to about 1.1 meters.

Wave period derived from the seismometer records varied from 5.2 to 9.0 seconds with a mean of 7.4 seconds (Figure 9). During the first half of the study, the wave periods ranged from about 6 to 9 seconds with an average of 7.5 seconds. Higher wave periods between 8 and 9 seconds represent swells which were probably generated hundreds of kilometers from the study area. The high waves on July 13 and 16 had fairly long periods. The 1.2 meter waves on July 26, however had periods of about 6 seconds and are probably locally generated wind waves. From July 26 through August 4, the waves remained fairly small with short periods, although the winds were over 10 meters/second along the coast. When the wave heights picked up again on August 6 and 10, the wave periods were also over 8 seconds.

## Wave Steepness

Wave steepness, which is the ratio of the wave height to its length, is considered by many to be a critical factor in determining whether erosion or deposition will take place on the beach. Two different wave steepness calculations must be considered in dealing with beach erosion. Offshore wave steepness is computed from the significant wave height and the deep water wave length, which is 1.56 times the square of the wave period. Breaker steepness, on the other hand, is much higher since the waves increase in height and decrease in length as they approach the shore. For most of the laboratory experiments where steepness is considered, the offshore wave steepness is used. It would seem however, that the breaker steepness should be used, because the sediment transport is taking place in the breaker zone. Since it has not been resolved which steepness value should be used, plots for both offshore wave steepness and breaker steepness are included (Figures 10a and b).

In computing breakers steepness, it is necessary to compute the shallow water wave length according to equation 2:

$$L = L_0 \tanh \frac{2\pi d}{L} \qquad (2)$$

where L is the shallow water wave length, $L_0$ is the deep water wave length and d is the breaker depth in shallow water. Since L appears on both sides of the equation, it

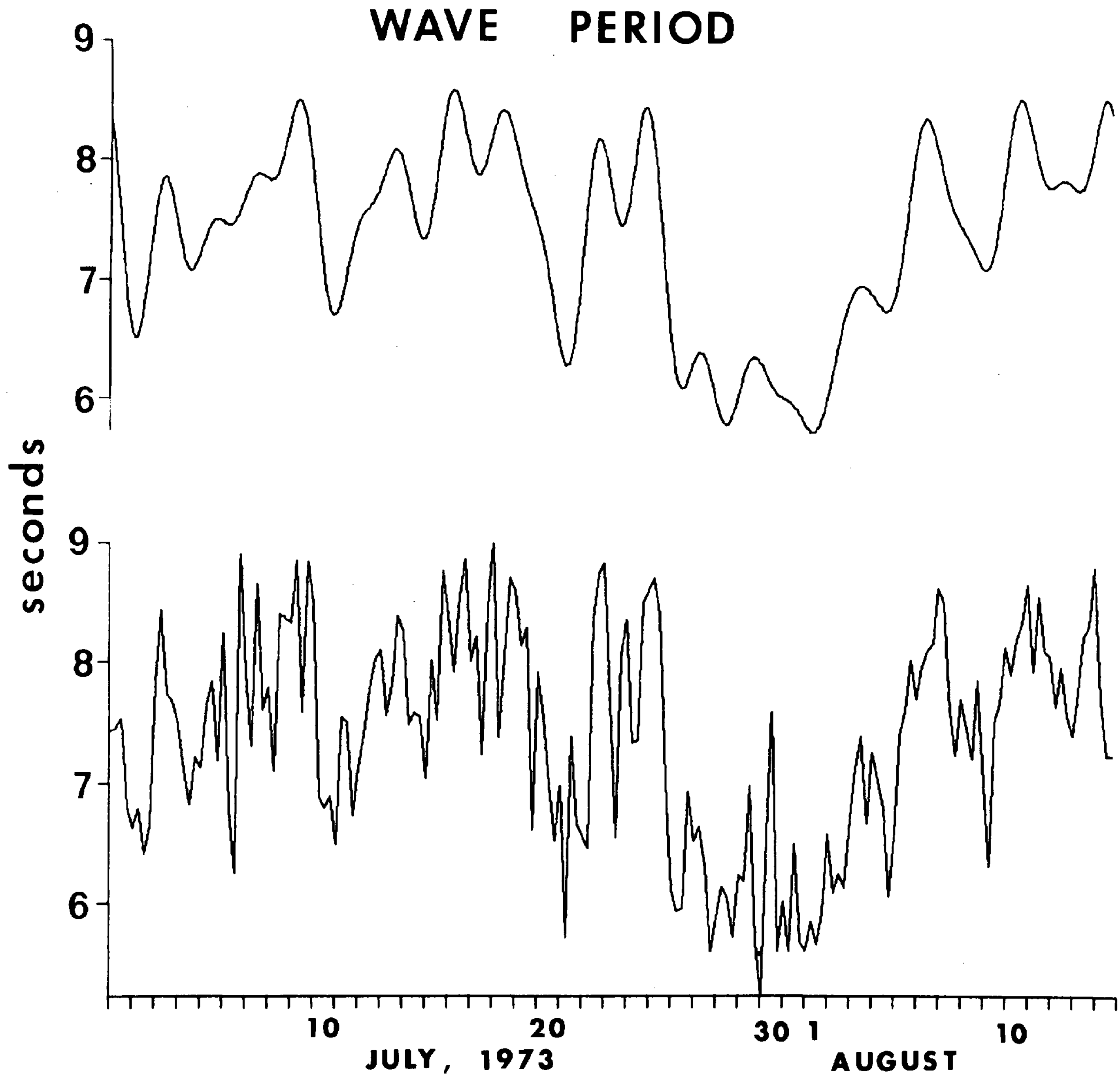



Figure 9. Smoothed and observed curves for wave period at Newport, Oregon.

is necessary to use an iterative method to obtain an approximate solution. For the first step of the iteration, the deep water wave length, $L_0$, is substituted for L on the right hand side of the equation giving equation 3:

$$L_1 = L_0 \tanh \frac{2\pi d}{L_0} \qquad (3)$$

then, the computed value for $L_1$ is substituted on the right hand side, and a new approximation for the shallow water wave length $L_2$ is obtained according to equation 4:

$$L_2 = L_0 \tanh \frac{2\pi d}{L_1} \qquad (4)$$

By repeating the iterative process 20 times, the value for L converges on the true value of the shallow water wave length.

The plots for offshore wave steepness and breaker steepness closely resemble each other in overall shape, but have significantly different absolute values (Figure 10). Offshore wave steepness varies from a minimum of 0.004 to a maximum of 0.021 with a mean of 0.01. As the waves move into the surf zone, the wave height is increased and wave length is decreased, causing a significant rise in breaker steepness. Breaker steepness ranged from a low of 0.020 to a high of 0.100 with a mean of 0.046. In general, the breaker steepness ranged from about 0.03 to 0.05, with peaks of 0.09 on July 13 and 0.10 on July 16. Lower peaks of 0.07 were recorded on July 26 and August 6. Offshore wave steepness was of course much lower. The highest values of offshore wave steepness 0.021 occurred on July 13 with lower peak values on July 16. The peak in breaker steepness on July 16 is higher for offshore steepness, but the peak for August 6 is lost in the background noise for offshore steepness.

## Wave Energy

Wave energy is probably the best indicator of the amount of work the waves can do on a beach. In general, wave steepness determines whether the waves will be constructive or destructive, and wave energy gives an estimate of the magnitude of the work that can be done in a given length of time.

According to small amplitude wave theory, the amount of energy, E, in foot pounds per linear foot of wave crest in a single wave is given by equation 5:

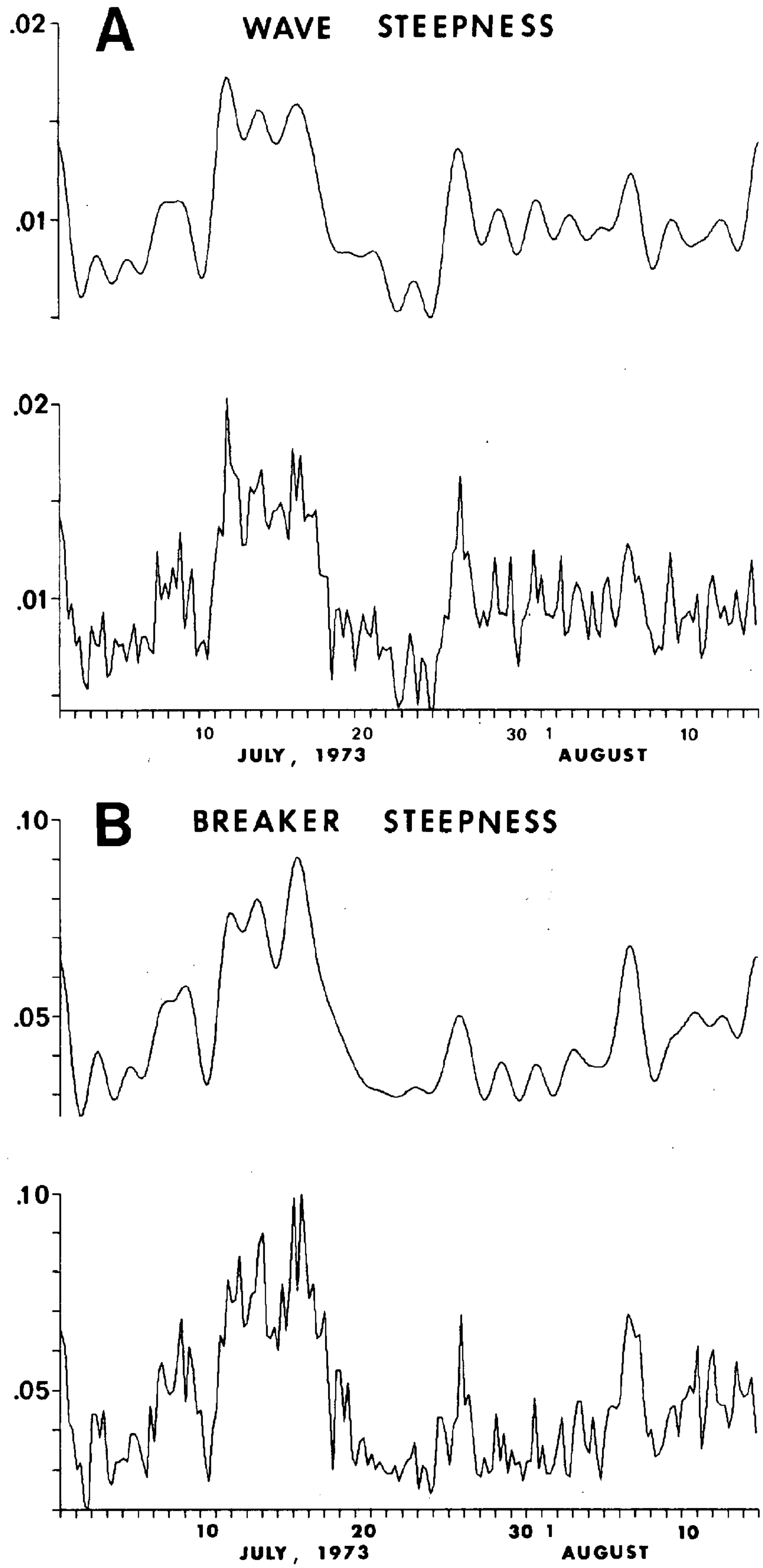



Figure 10. Smoothed and observed curves for (A) offshore wave steepness and (B) breaker steepness at Newport, Oregon.

$$E = \frac{wLH^2}{8} \qquad (5)$$

where w is the weight of one cubic foot of water (64 pounds). Since the wave energy depends on the square of the wave height, it increases exponentially as the significant wave height is increased. This equation can be applied to waves of low amplitude in deep water. Energy can be computed for shoaling waves according to Gerstner's theory which includes rotational water motion (King, 1972). The energy equation for waves of finite height is:

$$E = \frac{wLH^2}{8}\left(1 - 4.93\,\frac{H^2}{L^2}\right) \qquad (6)$$

The curve for wave energy (Figure 11) closely resembles the curve for breaker height (Figure 7), with high and low points in the same positions. Because wave energy is a function of the square of the breaker height, the maxima on the wave energy curve are exaggerated and emphasize intervals of high waves which have the greatest effect on beach erosion. The maximum wave energy was 19,203 foot pounds per linear foot of beach on July 16 and the mean was 3,556 foot pounds.

## Tides

Tides on the Oregon coast have an important influence on beach processes. With a small beach slope and large tidal range, the effect of wave action is spread across a broad portion of the beach. During spring tides, the beach is about 300 meters (1000 feet) wide at low tide and less than 10 meters (30 feet) wide at high tide.

The Oregon coast has a mixed diurnal-semidiurnal tide with spring tide range of 4.0 meters and a neap tide range of 2.0 meters (Figure 12). The diurnal inequality of the tides is greatest at spring tide when the lower low tide is 1.4 meters lower than the higher low tide. There appears to be a greater inequality between the low tides than between the high tides. The largest spring tides occurred on July 1 and July 30, with smaller spring tides on July 14 and August 14. Tide data at hourly intervals were extracted from a recording gauge located on the Oregon State University Marine Science Center dock on Yaquina Bay. The observed heights were adjusted to mean lower low water (MLLW) which is the datum used for soundings on Pacific coast nautical charts. The MLLW is 1.44 meters (4.73 feet) below mean sea level based on the 1929 datum and 1.375 meters (4.51 feet)

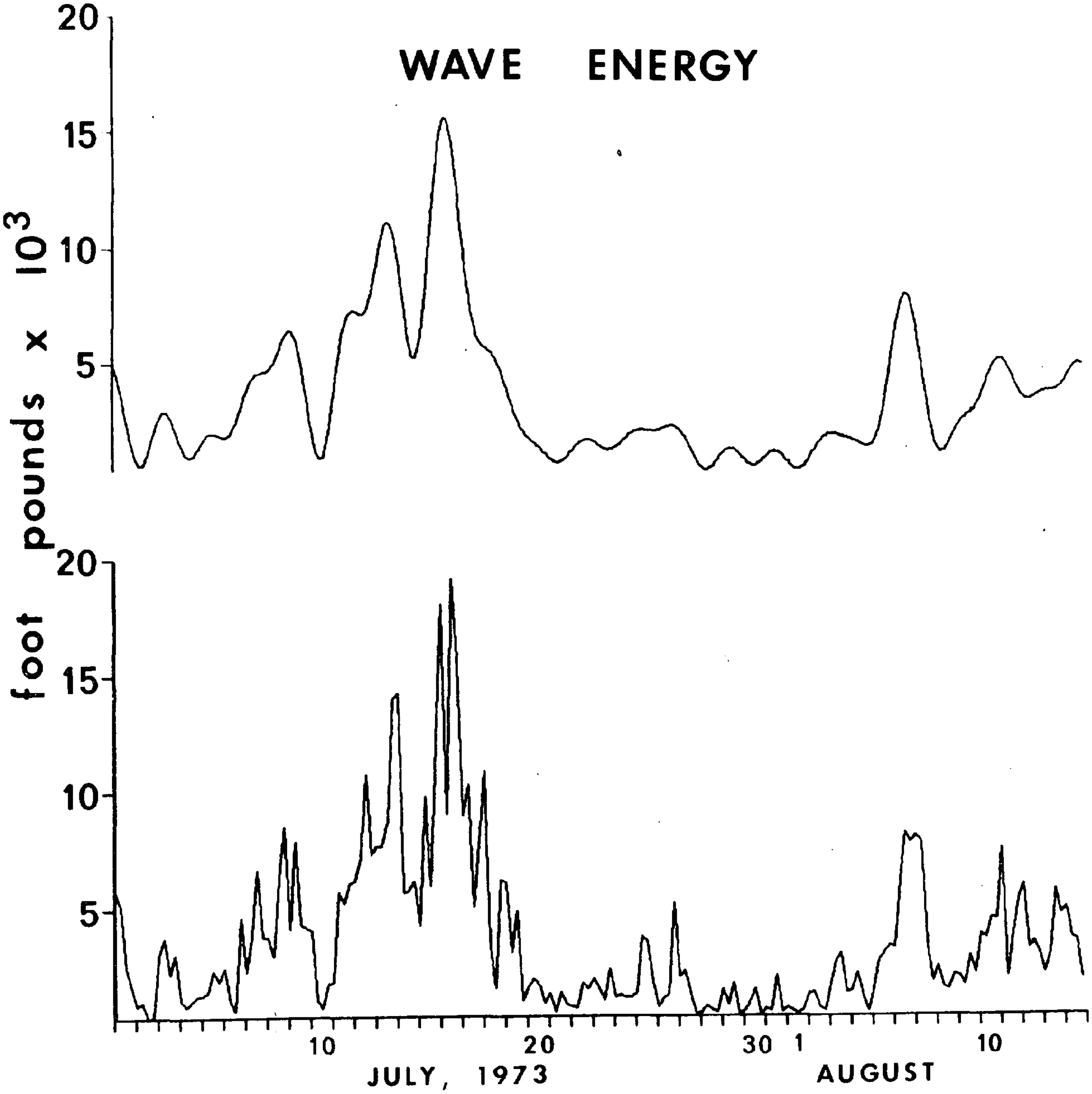



Figure 11. Smoothed and observed curves for wave energy at Newport, Oregon.

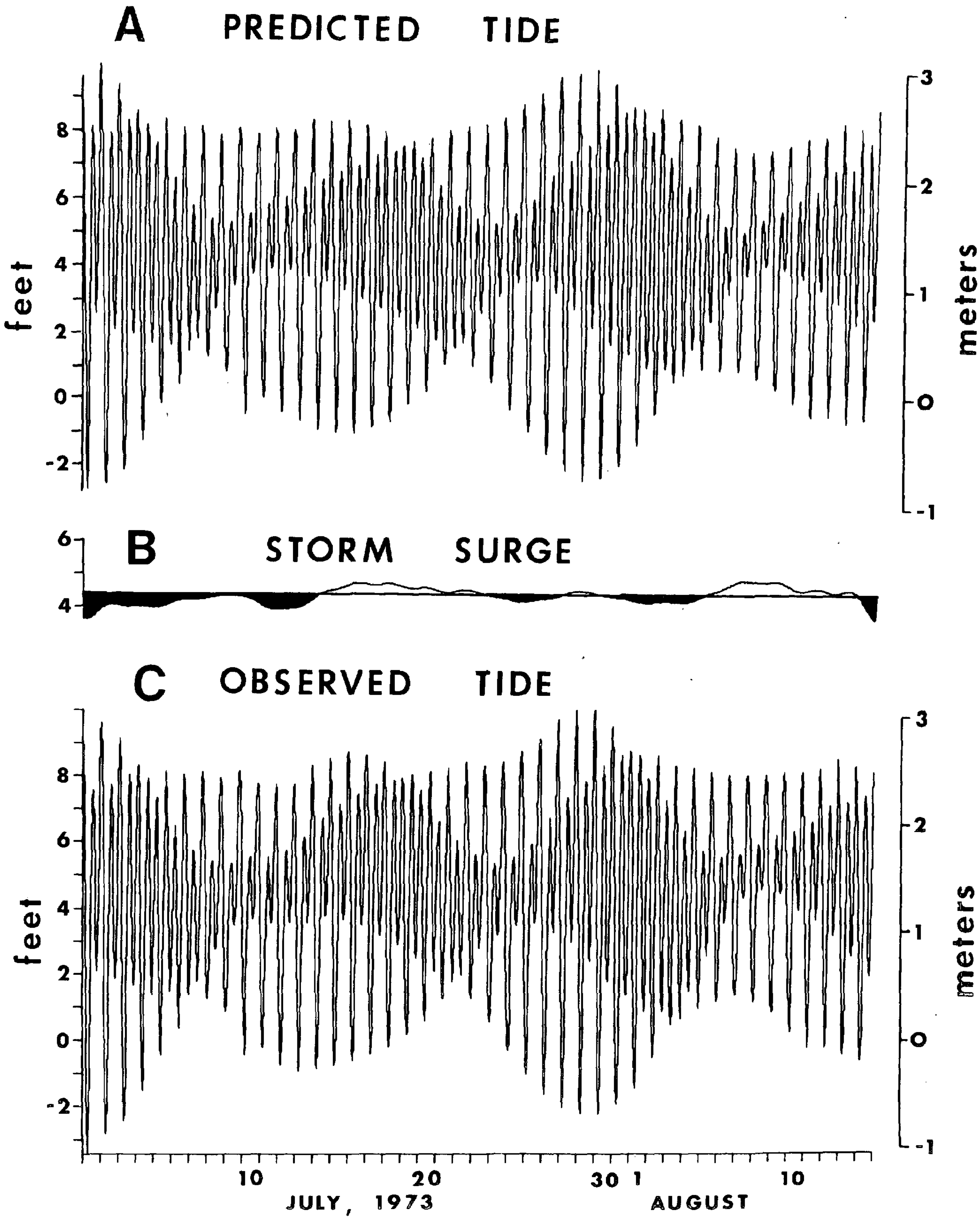



Figure 12. (A) Predicted tide, (B) storm surge and (C) observed tide in Yaquina Bay at Newport, Oregon.

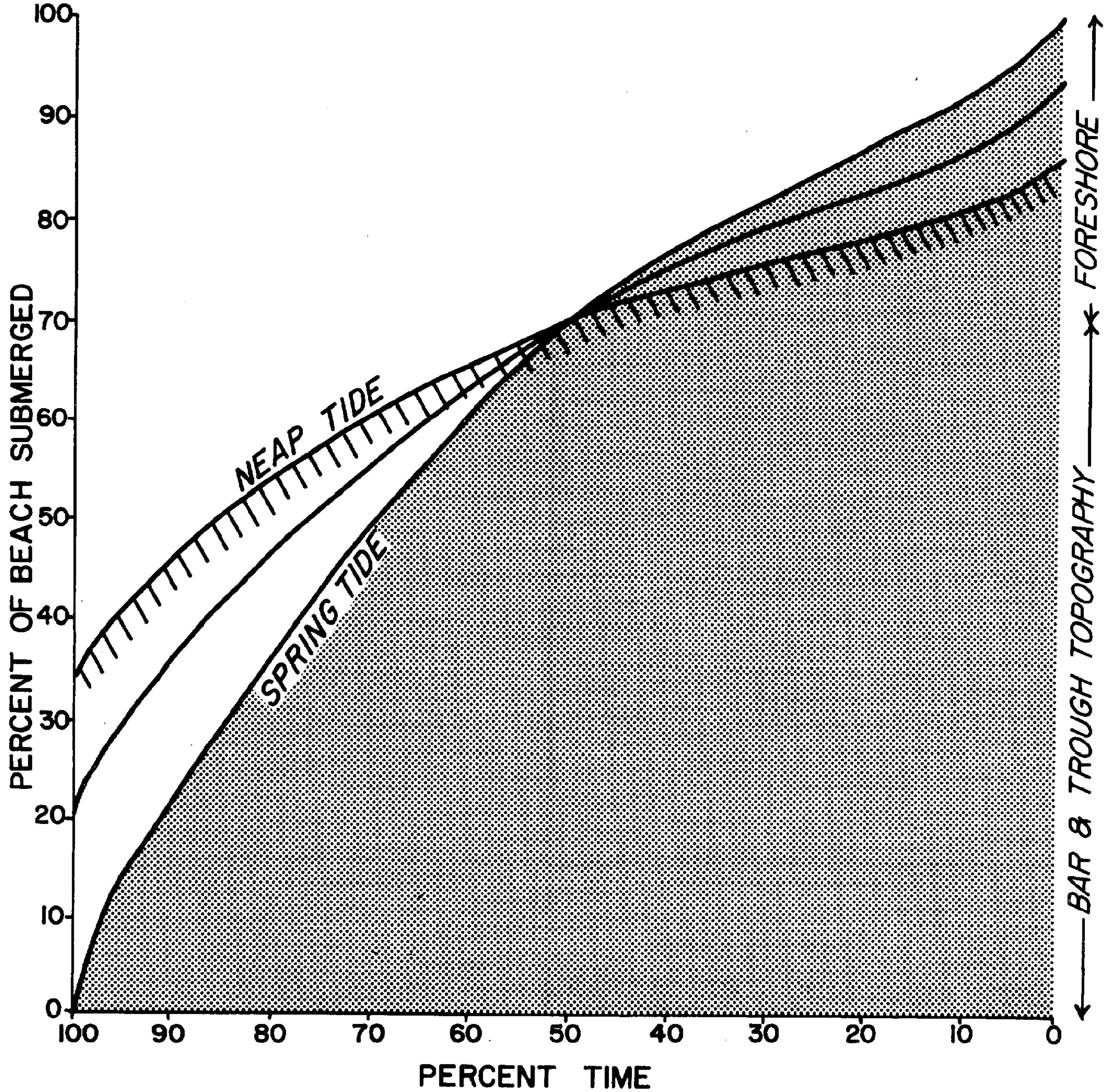



Figure 13. Percent of beach submerged during neap and spring tide at Newport, Oregon.

below the local mean sea level based on the hourly height readings. Mean high tide is 2.32 meters (7.61 feet) and mean low tide is 0.47 meters (1.54 feet) above MLLW.

In the analysis of beach erosion and deposition, the most important aspect of the tides is the percentage of beach area submerged at different times during the monthly tidal cycle (Figure 13). The beach which is about 300 meters wide at the study site near South Beach is considered 100 percent exposed or 0 percent submerged at low spring tide. At high spring tide when the beach is 10 meters wide, it is considered 100 percent submerged. The beach surface is concave upwards with a steeper slope of about 1:35 on the forebeach and a more gentle slope of about 1:100 in the bar and trough area (Figure 13). At mid-tide about 70 percent of the beach is submerged, so that most of the wave action is concentrated on the upper portion of the beach. The bars and rip channels are formed below mean sea level, while the steeper forebeach is above mean sea level. At neap tide, the beach is 35 percent submerged at low tide and 85 percent submerged at high tide.

## Nearshore and Longshore Currents

Nearshore currents were measured twice each day, at 0800 and 2000, at the South Beach study site. On days when the South Beach area was being surveyed for beach maps, nearshore current observations were also made at 1400. A plastic "whiffle ball" attached to a 15 meter nylon line was used to measure the surface speed and direction of the currents. The wiffle ball was released in the surf zone and the time and azimuth was recorded for the ball to travel 15 meters.

Nearshore current observations were made at 3 locations in the surf zone in a depth of one meter. For most of the study, a rip current was present between two bars about 200 meters south of the north end of the study area. Therefore, current measurements were made in the center of the rip channel, 30 meters north, and 30 meters south of the rip. With the changes in water depth during the daily tidal cycle, the currents could be sampled at different positions across the beach.

A nearshore current experiment was conducted on August 4, 1973 to show the pattern of currents on a 30 meter grid spacing in the bar and trough region (Figure 14a). The experiment was held during a rising tide at about mid-tide when waves were approaching from the northwest. On the forebar or seaward edge of the sand bar, the current

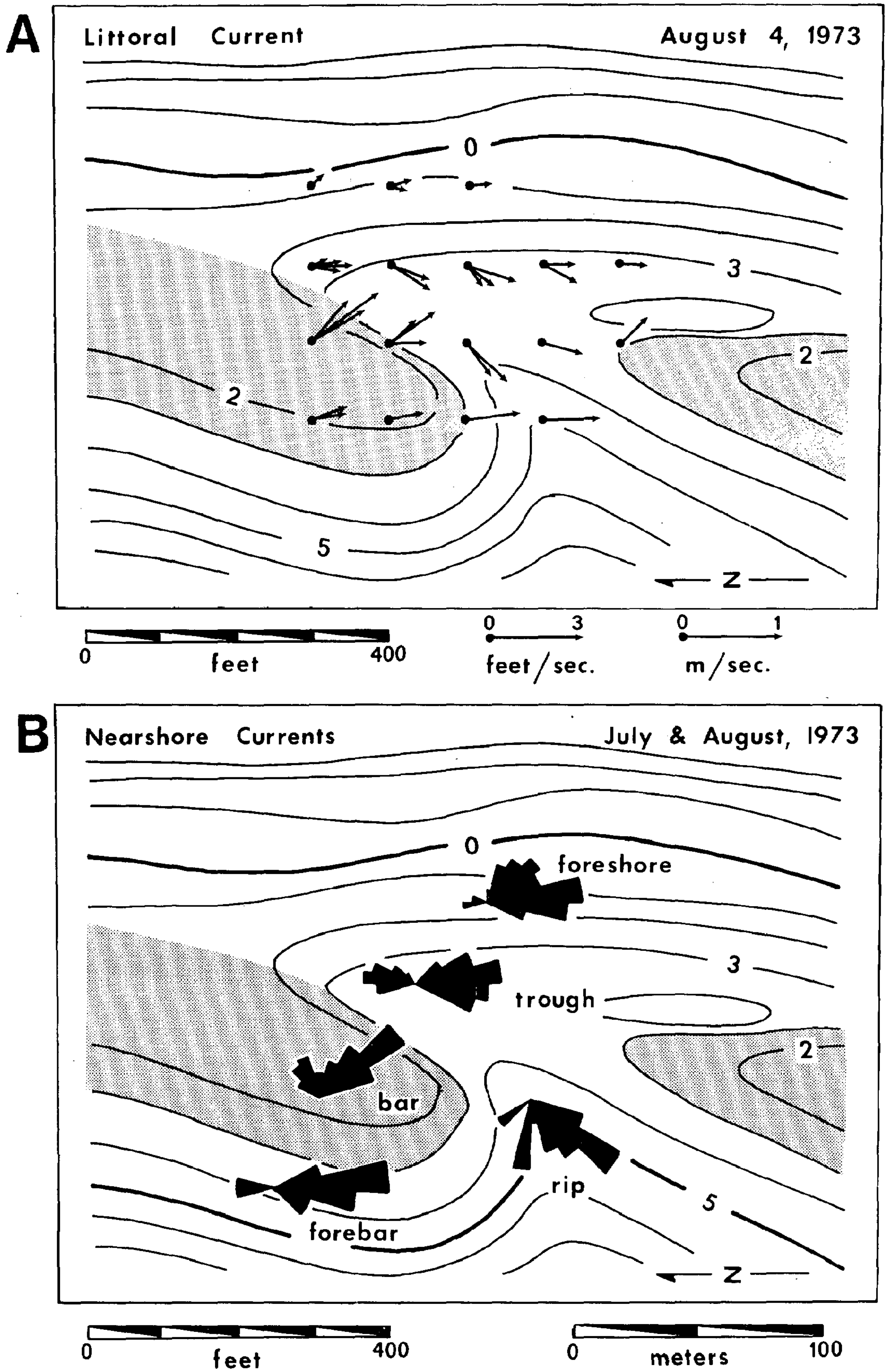



Figure 14. Maps of (A) littoral current vectors in the surf zone on August 4, and (B) current roses for current direction in the foreshore, trough, bar, forebar and rip currents for July and August at South Beach, Oregon.

was flowing to the south at 60 centimeters/second. Over the bar, the current flowed at 80 centimeters/second at an angle to the bar due to the influence of wave action. In the trough shoreward of the bar, the current moved to the south at 50 centimeters/second and out the rip channel at about 60 centimeters/second. On the foreshore, the current velocity dropped to 20 centimeters/second and was directed up the beach. The overall current pattern in the experiment showed a longshore transport both seaward and shoreward of the bar, with onshore transport across the bar, and offshore transport in the rip between the bars. The highest velocities were recorded on the bar and in the rip channel, with the lowest velocities on the foreshore.

Current roses are plotted for currents on the forebar, bar, rip channel, trough and foreshore using all the directional data from July and August, 1973 (Figure 14b). The map for August 4 was used for the littoral current experiment and also as a base for plotting the current roses. On the forebar, the current directions are predominately to the south with some reversals to the north. The current reversals were due to changes in wave direction from northwest to southwest. On the bar, the current directions are shifted shoreward due to the influence of breaking waves. In the trough, the north-south current direction returns, but the spread in current directions is greater than on the forebar. In the rip channel, the current is directed offshore to the southwest, with some currents straight offshore and to the northwest. On the foreshore, the current directions are much more varied, again showing the effect of waves surging toward the shore.

There is a close similarity between the current pattern shown by the littoral current experiment conducted on August 4, 1973, and the plot of current roses for the directional data collected during July and August. Although the bars shifted position somewhat during the study, the general current pattern persisted for the 45 day period.

The vector mean current velocity was plotted to show the change in current velocity through time (Figure 15a). The highest velocity was 92 centimeters/second (3.04 feet/second) at 1400 on August 11. Swift currents were also recorded on July 29 and August 1. There is no apparent close relationship between nearshore current velocity (Figure 15a) and breaker height (Figure 7b) as might be expected. Because the current is dominately longshore, stronger currents are developed when the waves approach the shore at a large angle. The larger waves are refracted so that they approach the shore at a smaller angle and generate a slower longshore current. With the proper combination

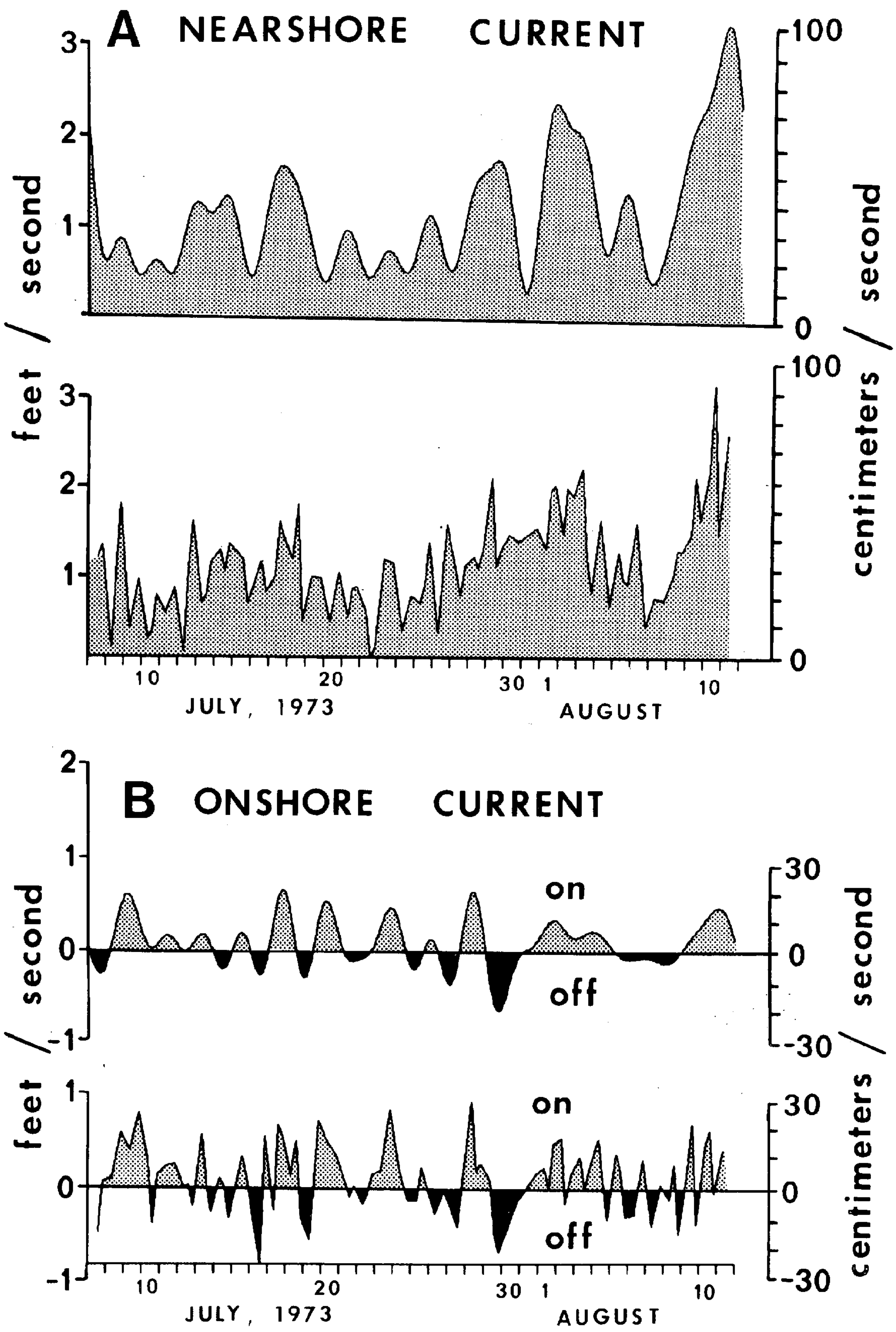



Figure 15. Smoothed and observed curves for (A) nearshore current and (B) onshore component of the current in the surf zone at South Beach, Oregon.

of wave angle and breaker height, the fastest longshore currents are generated.

The onshore component of the nearshore current was computed from the current velocity and directional data (Figure 15b). In general, the onshore and offshore components are less than 30 centimeters/second. The onshore component occurs more frequently than the offshore component due to the shoreward transport of waves. The offshore component due to rip currents was strongest on July 16 when it reached 25 centimeters/second.

The longshore component of the nearshore current was much stronger than the onshore component and reached a maximum of 90 centimeters/second on August 11 (Figure 16). The positive longshore current moves to the south and the negative current flows to the north. The northward flowing longshore current was generated when the waves shifted to the southwest.

There is a close relationship between longshore wind and longshore current (Figure 17). Lows in barometric pressure correspond quite closely to reversals in wind direction and longshore current for the first half of the study. The lows in barometric pressure on July 2, 5 and 17 correspond to changes in wind direction from north to south. The lows in barometric pressure on July 27 and August 4 do not follow the same pattern with corresponding reversals in wind directions. The normal reversal in wind direction is seen with the barometric low on August 12. The lows for July 27 and August 4 moved north along the coast from California and may not have sufficiently displaced the east Pacific subtropical high to cause a reversal in wind direction. The longshore current follows the same pattern as the longshore wind, but with a 2 to 3 day lag in direction reversal (Figure 17). The longshore current shifts from north to south on July 7 and 19 following the reversal in wind direction on July 5 and 17. The rose diagrams for wind and nearshore currents are also quite similar.

In summary, the nearshore current pattern is controlled by topography, tidal stage and angle of wave approach. Longshore currents dominate during high and low tide and rip currents are more important during mid-tide. There is a close correspondence with a time lag between reversals in wind direction and longshore current. The strongest currents are developed when waves of intermediate height approach the shore at a high angle to the beach.

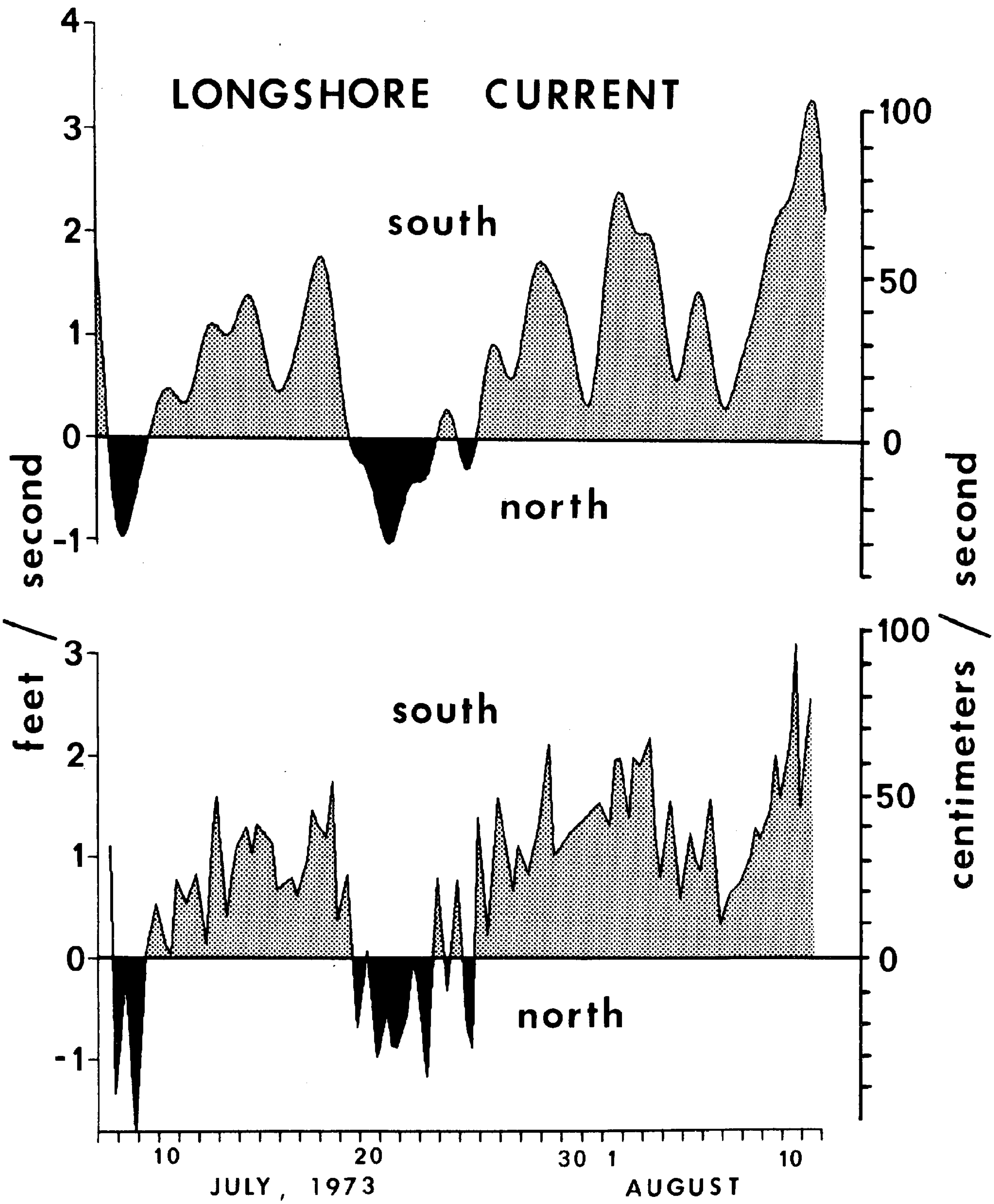



Figure 16. Smoothed and observed curves for the longshore component of the current in the surf zone at South Beach, Oregon.

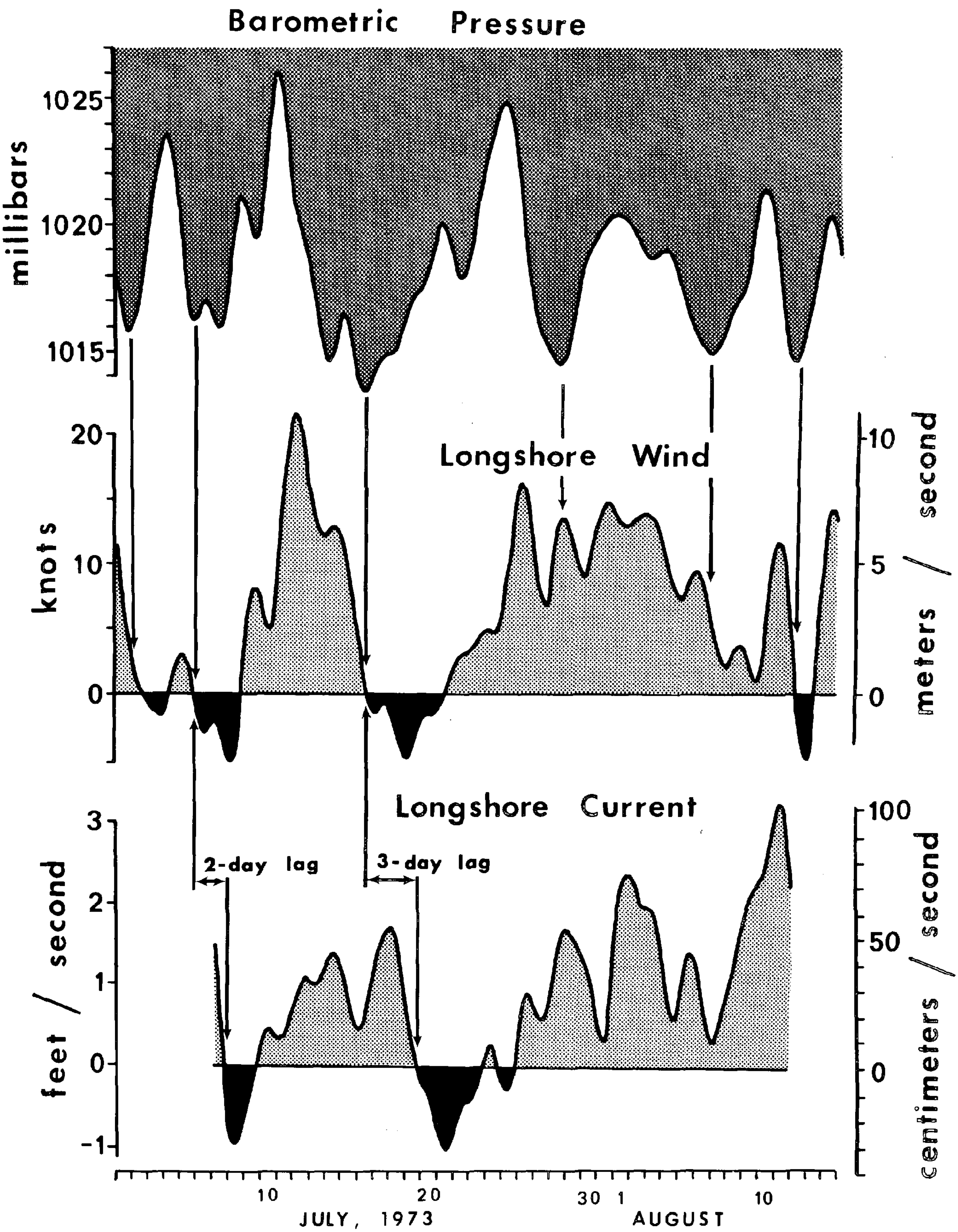



Figure 17. Smoothed curves showing alignment of lows in barometric pressure with reversals in direction of longshore wind and lag in reversals of longshore current.

## NEARSHORE TOPOGRAPHY

### Mapping Programs

Beach and nearshore bar topography was monitored at three study sites, South Beach, Beverly Beach and Gleneden Beach, Oregon (Snavely, MacLeod and Rau, 1969). Maps were made at three or four day intervals depending on the tide and local wave conditions (Davis and Fox, 1971). At each study site, a baseline was laid out parallel to the shore and as close to the cliff as possible. Nine stakes were placed at 61 meter (200 foot) intervals along the baseline. A third order level line was run along the baseline to establish the elevation at each stake with reference to the first stake in the sequence. To determine the absolute elevation of the baseline, a level line was run from the baseline to mean sea level while sea level elevation was being read at a tide gauge two miles north.

Each area was mapped by surveying a series of profiles from the baseline across the beach and as far as possible into the surf. When visibility was good enough to see the horizon, the stake and horizon method was used to establish differences in elevation along each profile, Emery (1961). Two five-foot stakes marked at .003 meter (1/100 of a foot) intervals and a 6.1 meter (20 foot) rope were used for the survey (Figure 18a). By sighting from one stake over the top of the other to the horizon, it is possible to measure the changes in elevation at 6.1 meter intervals perpendicular to the baseline. Under foggy conditions, a hand level was used in place of the horizon. Secondary stakes were placed along each profile line at 61 and 122 meters (200 and 400 feet) and the baseline. The elevations of the secondary stakes were established by running level lines from the baseline. The secondary stakes were used to provide a line of sight for the profiles, and as a check for the accuracy of the stake and horizon method. The stake and horizon method proved to be accurate within third order surveying limits (1:500).

An attempt was made to time the survey so that it would bracket the lowest tide of the day. Under normal conditions without fog, rain or high waves, the survey took about 2-1/2 to 3 hours to complete. Therefore, the survey was normally started about 1-1/2 hours before predicted low tide. When low tide occurred early in the morning or late at night, an attempt was made to at least include low tide within the survey. In more than one instance, the early morning surveys were started in the dark at 4 a.m. and completed before the sun made it over the cliffs.

South Beach, Oregon

The primary study site at South Beach, Oregon was located about 3 kilometers south of the south jetty at the mouth of the Yaquina River in Newport, Oregon (Figure 1). A 488 meter (1600 foot) baseline was laid out in front of the Sea Vista Motel with the 305 meter (1000 foot) stake at the base of the stairs leading down from the cliff. The north end of the baseline was 30 meters south of Moore Creek and 25 meters from the cliff. The baseline extended to the south and was 2 meters seaward from the base of the cliff at the notch in front of the Sea Vista Motel (Figure 18b).

The beach covers a wave-cut terrace and abuts a cliff cut in the Nye Mudstone which is overlain unconformably by Pleistocene Marine Terrace deposits (Lund, 1972). In summer, the wave cut terrace is covered with a well-sorted, fine grained sand (Rottman, 1973), but in winter, ledges of more resistant siltstone and large concretions protrude through the sand (Figure 19a). In summer, the layer of sand is about 1 to 2 meters thick over the wave cut terrace. Slumpage and landslides were evident at several places along the cliff at South Beach (Figure 19b). South of Ona Beach State Park, about 8 kilometers to the south, the sand was completely removed during the winter leaving a rugged topography with rows of concretions several feet high on the wave cut terrace.

At the beginning of the study, two lines of low amplitude bars were present as shown in the air photo from July 2, 1973 (Figure 20a). The first map of the area was made at spring low tide on July 4, 1973 (Figure 21a). On the maps, the contour interval is in feet with north to the left. The cliff and baseline extend across the top with the Pacific Ocean at the bottom of the map. The contours extend from 8 feet (2.44 m) below to 7 feet (2.13 m) above mean sea level.

The beach consists of a gently sloping foreshore above mean sea level and a series of sand bars and rip channels below the mid-tide mark (Figure 21a). The foreshore extending seaward from the baseline to mean sea level has an average slope of 1:30 (Bascom, 1951). A longshore rhythm on the foreshore has a wavelength of about 400 meters and an amplitude of 1 meter. From 0.5 meters above to 0.5 meters below mean sea level, the beach slope decreases to about 1:60. On July 4, 1973, a small bar was present just below

Figure 18a. Surveying across South Beach at low spring tide. Distance between men is 100 feet and beach is 800 feet wide.

Figure 18b. Cliff and beach at high tide, South Beach, Oregon.

Figure 19a. Rock ledge exposed on Beverly Beach, January 1, 1973.

Figure 19b. Landslide on the cliff at South Beach, January 19, 1973.

mean sea level on the 427 meter (1400 foot) profile.

Two lines of bars were present below mean sea level on July 4, an inner line about 140 meters and an outer line about 230 meters from the baseline (Figure 21a). The north inner bar, bar A, arches gently southward for about 200 meters. The crest of the bar A 1.3 feet (0.4 meters) below mean sea level. The north outer bar, bar B, at 200 meters from the baseline reaches 60 meters to the south. Bar C, has a broad oval shape and extends south from the 300 meter profile past the edge of the map at the 500 meter profile. Bar D, resembles a prong extending northward from bar C. Since bar D is later separated from bar C, it is considered a separate bar on the initial map. Bar E is a northward extending finger of sand near the center of the map. Rip channels separate bars A and E and bars B and D. Longshore troughs exist in front of bars A, C and E and between bars A and B, and bars D and E (Figure 21a).

For the period from July 4 to 10, the waves increased to a maximum height of 1.5 meters (Figure 7). Winds were mainly out of the southwest with a shift to the northwest on July 5 (Figure 6). Tides decreased from maximum spring tides with a range of 4.0 meters on July 1 to neap tides with a range of 2.0 meters on July 8 (Figure 12).

Littoral current measured on July 7 and 8 reached a maximum of 55 centimeters/second. The longshore component of the current reached 52 centimeters/second to the north on July 8 when the wind and waves were out of the southwest. The longshore current measurements were taken within the inner bar system where the current was flowing to the north. A rip current system with megaripples (Clifton, Hunter, and Phillips, 1971) was operating shoreward of the inner sand bar with feeder currents moving to the south in front of bar A. Although the longshore current was flowing to the north on July 7 and 8, sediment was being transported to the south by the feeder currents in the rip current system. Bar C, which moves shoreward and northward at 9.1 meters/day was acting under the influence of the northward longshore current.

The topographic maps for July 4, 7 and 10 show a progressive shoreward and longshore movement of the initial bars (Figure 22a-c). Bar A, is welded to the shore at the north end and advances 10 meters/day to the south. Bar B moves 5.5 meters/day toward the shore and 16.8 meters/day to the south. Bar C advances toward the shore at a rate of 4 meters/day and northward at 9.1 meters/day. Bar D, the northward extension of bar C, is cut off from bar C by a rip channel on July 7. On July 10, bar D migrated toward

Figure 20a. Bars A and B at the north end of South Beach. Megaripples present in the troughs, July 2, 1973.

Figure 20b. Bars C and G at South Beach, July 21, 1973.

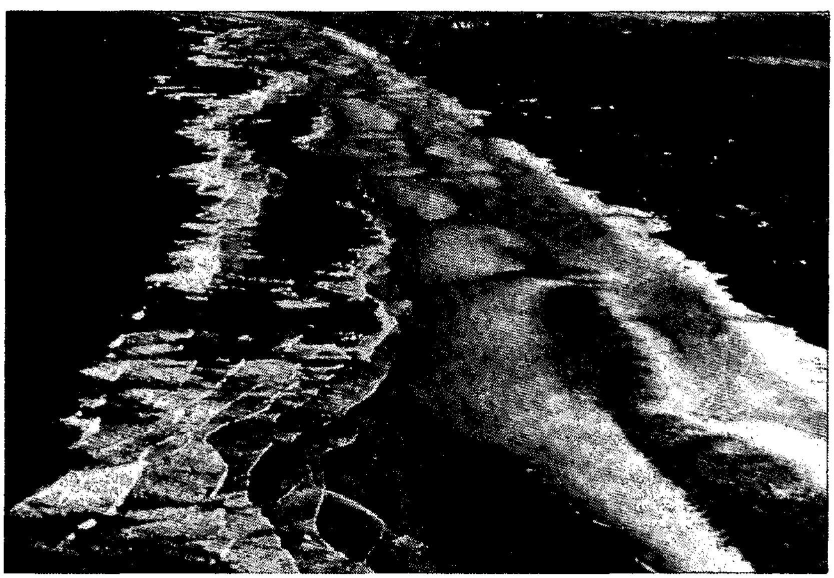


Figure 20c. Bars H, C and G at South Beach, August 2, 1973.

the shore and welded on to the south end of bar A. Bar E, advanced toward the shore at 4 meters/day and was welded to the beach on July 10. Bar F, the small bar at mean sea level near the south end of the map, moved shoreward at 6.1 meters/day and was welded on the beach on July 7.

The net topographic changes from July 4 through July 10 form sausage shaped mounds on the erosion and deposition map (Figure 22d). The areas of deposition on the north half of the map represent the shoreward, but predominantly southward advance of bars A and B. The depositional areas on the south end of the map are the leading edges of bars C and E with areas of erosion to the south and west.

The wave and current conditions reached a peak between July 10 and 18 resulting in considerable erosion on the beach and deposition on the bars. From July 10 through 12, the wind speed reached almost 15 meters/second out of the north as a high pressure system hovered offshore (Figure 4). On July 13, the waves reached 1.8 meters in height with periods of 8.5 seconds (Figure 9). The longshore current was about 45 centimeters/second to the south. As a low pressure system moved across on July 13 through 17, the wind shifted over to the southwest and dropped off to 2 to 4 meters/second. The shift in wave and longshore current direction did not take place until July 19 (Figure 16). However, the waves reached their maximum height of 2 meters and period of 9 seconds on July 16 (Figure 7). The waves were actually swells which were generated out at sea and approached the shore almost parallel to the coast. Spring tides occurred on July 12 through 15, but the tidal range was only 2.7 meters so wave energy was concentrated in the mid-tide zone (Figure 13).

The maps for July 10, 14 and 18 show significant changes in the beach and nearshore bar configurations (Figures 21c and 23a-c). Between July 10 and 14, bar B merged with bar A which advanced 11.3 meters/day to the south (Figure 23b). A rip channel was maintained between bars A and C about 300 meters from the north end of the study area. Bar C was eroded 12 meters/day on the north edge and built out toward the south. The greatest changes in the shoreline configuration took place between July 14 and 18 (Figure 23c). Bars A and C merged, forming one large bar extending to the south end of the map. The longshore current in the trough between the bar and the shore excavated the trough to a depth of 1.9 meters on July 18. As the waves subsided, a new bar, G, formed 210 meters from the baseline near the north end of the map.

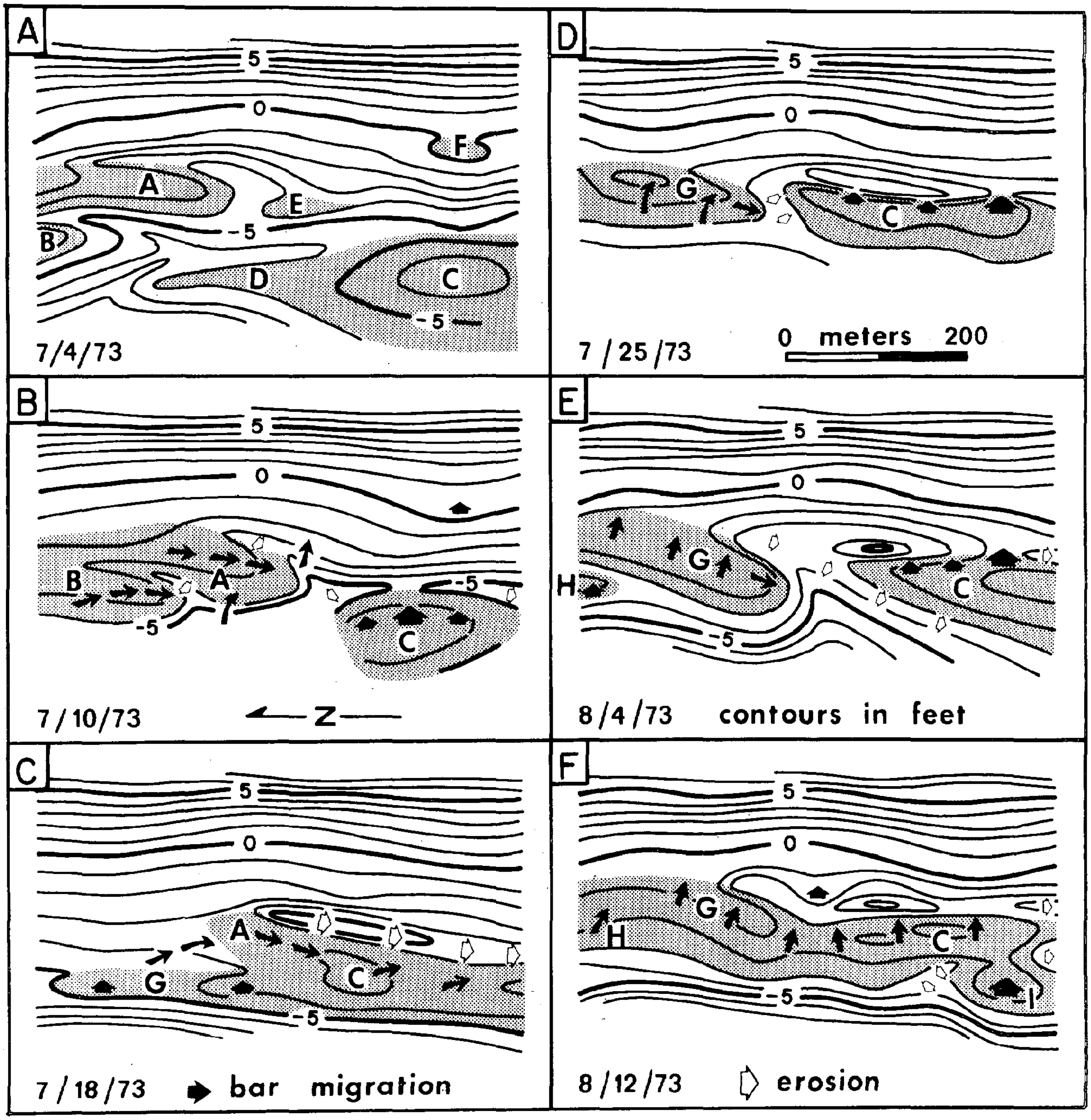



Figure 21. Sequence of maps showing bar migration and erosion at South Beach, Oregon.

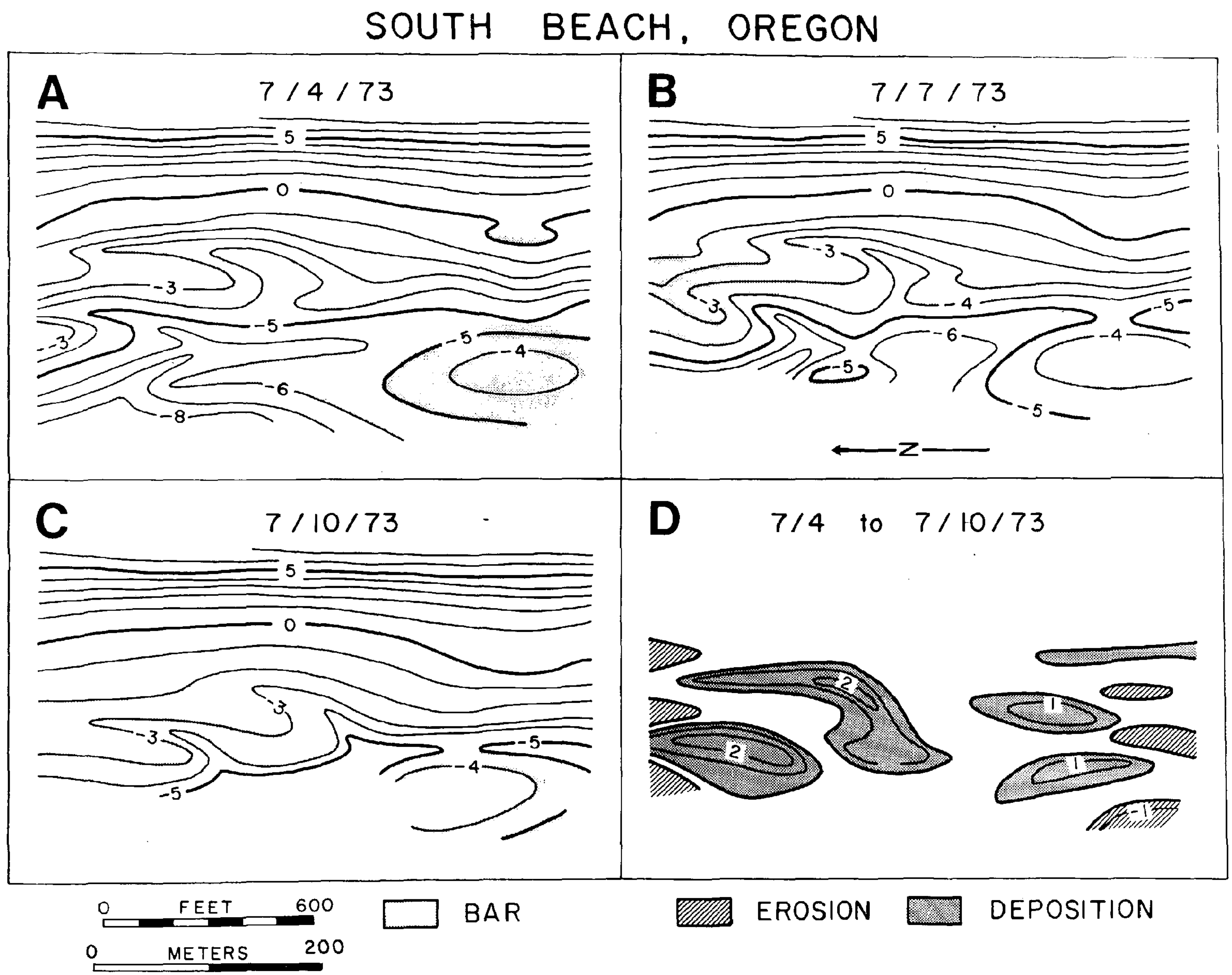



Figure 22. Topographic maps for (A) July 4, (B) July 7, (C) July 10, and (D) erosion and deposition map for July 4 to 10, 1973 at South Beach, Oregon.

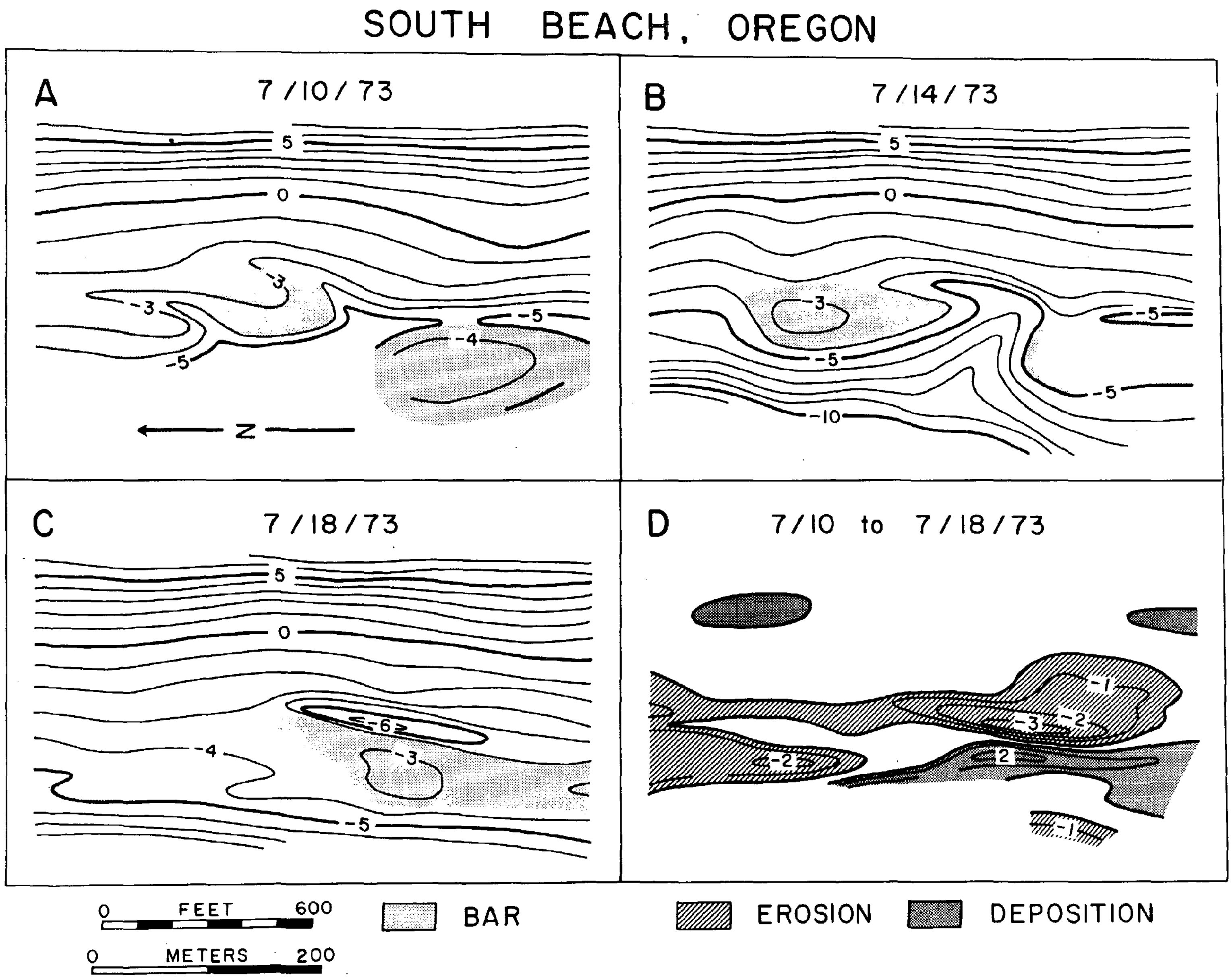



Figure 23. Topographic maps for (A) July 10 and (B) July 14, (C) July 18, and (D) erosion and deposition map for July 10 to 18, 1973 at South Beach, Oregon.

The map for erosion and deposition between July 10 and 18 showed up to 2 feet (0.6 meters) of deposition shoreward of bar C with erosion in the troughs in front of bars C and G (Figure 23d). When bars A and C were merged, 1 meter of erosion took place in the longshore trough exaggerating relief on the bar (Figure 23d). Up to 0.6 meters of erosion occurred forming a trough in front of bar G.

From July 18 to 25, the wind dropped down to less than 4 meters/second and breaker height was less than 1 meter for the lowest energy conditions during the study. The bars advanced slowly toward the shore filling in the troughs ahead of them (Figure 21d). From July 18 to 22, bar G at the north end of the map advanced 58 meters toward the shore at an average of 14.3 meters/day (Figure 24b). The crest of bar G rose from 1.3 to 0.5 meters below mean sea level. From July 22 to 25, bar G advanced shoreward an additional 15 meters and started to build out to the south (Figure 24c). Bar G moved shoreward at a rate of 5.5 meters/day at the north end and expanded 12.2 meters/day to the south. As bar G built up, a rip channel formed between it and bar C with a feeder trough in front of bar G. The map of erosion and deposition (Figure 24d) shows a broad area of deposition resulting from the shoreward advance of bars G and C and the filling in of the trough in front of bar C. The air photo taken on July 22, 1973 shows bar C with the trough at the south end of the study area (Figure 20b).

July 25 to August 4 was also a time of low energy in the surf zone. Wind speed reached 15 meters/second on July 26 (Figure 4) but the wind was almost entirely along the shore from the north. Breaker height picked up to 1.5 meters and longshore current reached 50 centimeters/second to the south. The wind and wave activity dropped off again from July 26 until August 4.

From July 25 through August 4, 1973 the bars continued to advance toward the shore and the rip channel expanded to the south (Figure 21e). Bar C continued to move toward the shore at a rate of 1 meter/day. Bar G built out to the south at 5.5 meters/day forcing the rip channel to migrate southward and erode bar C. On August 4, bar H formed offshore from bar G at the north end of the map. The map of erosion and deposition (Figure 25d) shows deposition due to the southward advance of bars C and G, a linear area of erosion in front of bar C and a triangular area of erosion due to the expansion of the rip channel between bars G and C.

Wind and wave activity increased somewhat between August 4 and 12. The waves reached 1.7 meters on August 6 and averaged about 1.4 meters through the end of the study.

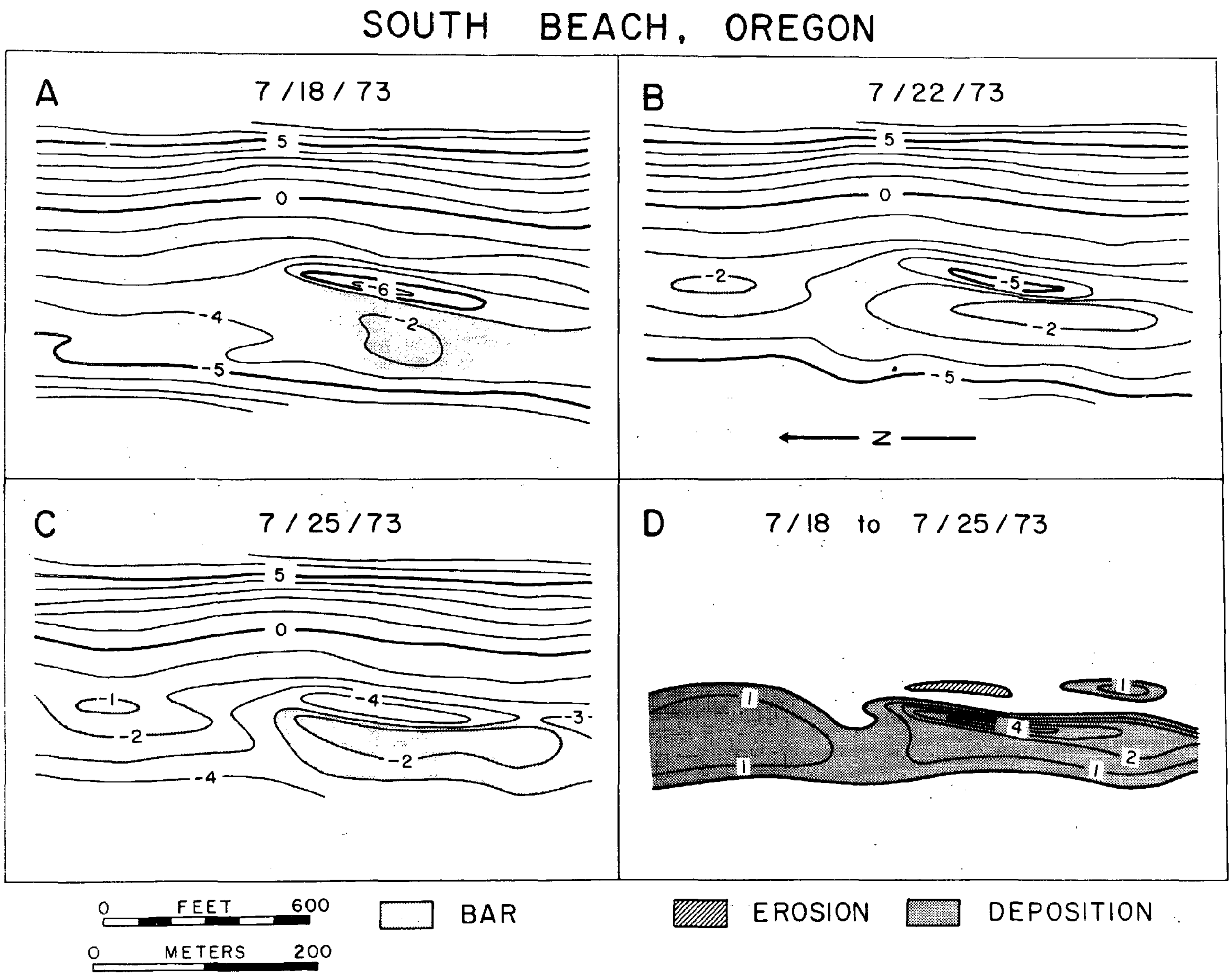



Figure 24. Topographic maps for (A) July 18, (B) July 22, (C) July 25, and (D) erosion and deposition map for July 18 to 25, 1973 at South Beach, Oregon

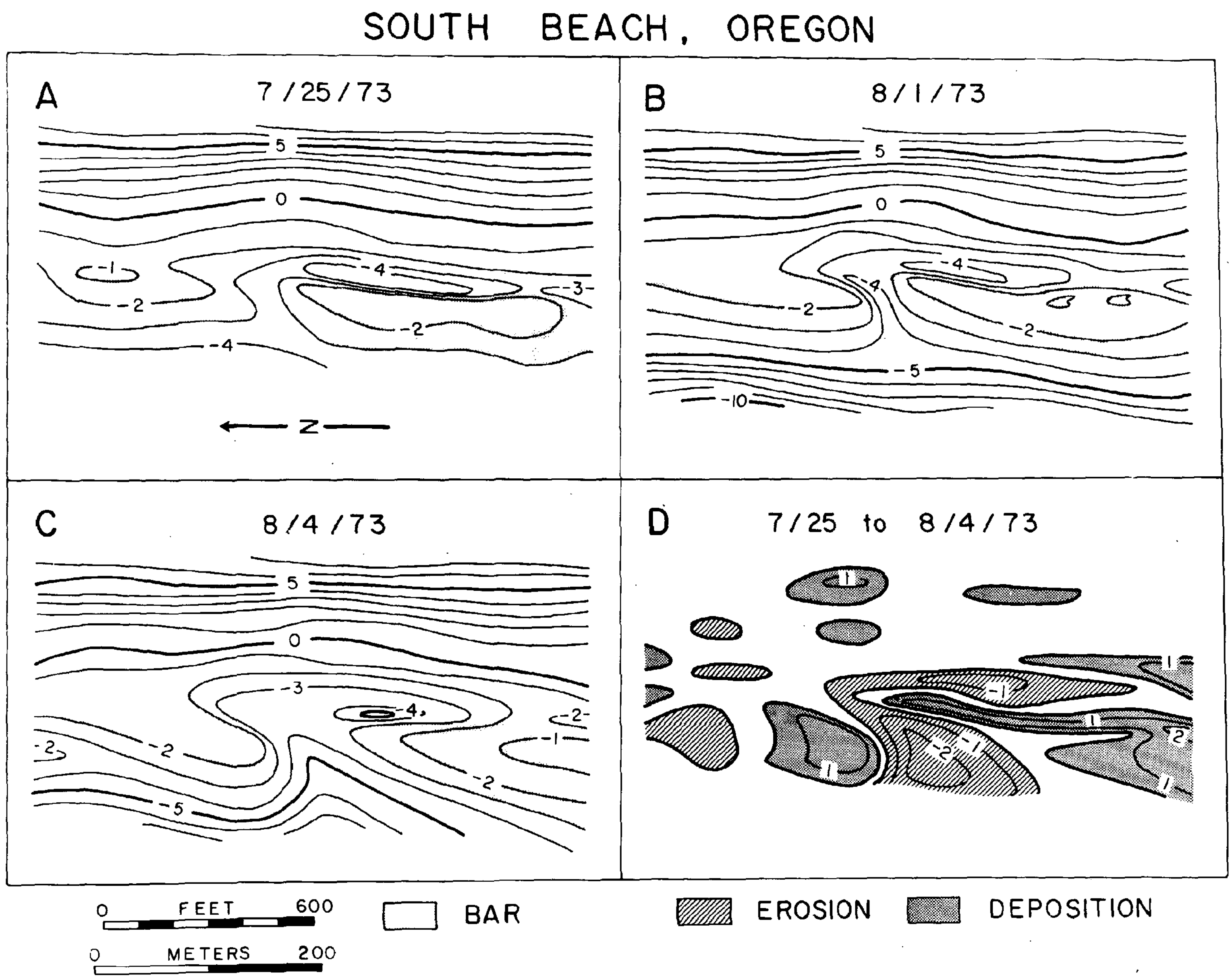



Figure 25. Topographic maps for (A) July 25, (B) August 1, (C) August 4, and (D) erosion and deposition map for July 25 to August 4, 1973 at South Beach, Oregon.

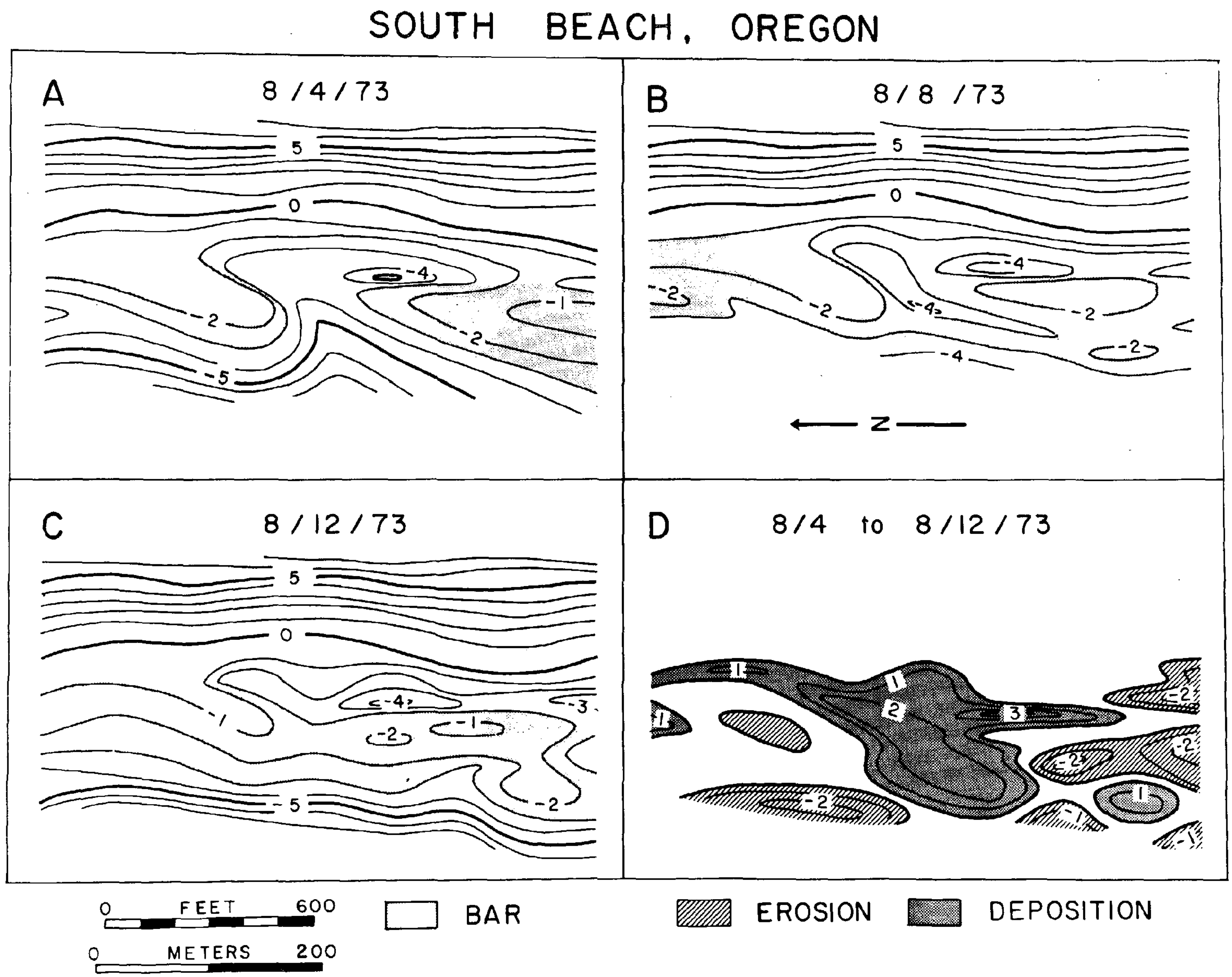



Figure 26. Topographic maps for (A) August 4, (B) August 8, (C) August 12, and (D) erosion and deposition map for August 4 to August 12 at South Beach, Oregon.

The longshore current reached a maximum of over 90 centimeters/second on August 10 in the trough between the bar and the shore (Figure 16).

The final maps for the summer series show the formation of new bars on August 8 and their advance toward shore on August 12 (Figures 21f and 26b). On August 8, a new bar formed outside bar C and joined with a southward extension of bar G (Figure 26b). On August 8, the rip channel is blocked off by the new bar, and by August 12, it is filled in with sand. Bar H at the north end of the study area was formed on August 4 and was welded on to bar G by August 12 (Figure 26d). When the study ended on August 12, bars G and C joined to form a single continuous bar, and bar I built up off the south end of bar C (Figure 21f). The erosion and deposition map shows a large depositional area in the old rip channel where bar G joined up with bar C (Figure 26d). Erosion took place on the seaward edge of bar G and in front of bar I.

In summary, the major mode of sand transport across the beach in the summer is in large intertidal sand bars. The bars form at a depth of 1 to 2 meters and advance toward the shore at 1 to 5 meters/day. During the summer the wind is generally out of the north-northwest at 5 to 15 meters/second with waves from 1 to 3 meters high. The northwest waves generate longshore currents to the south resulting in the southward migration of the bars. The rate of bar movement to the south varies from 10 to 15 meters/day. During storms, rip channels and longshore troughs are excavated by the longshore currents. At times of low wave activity, the bars advance shoreward and bury the longshore troughs.

## Beverly Beach

A second beach study was made at the south end of Beverly Beach State Park about 11.7 kilometers (7 miles) north of the Newport jetty at Yaquina Bay (Figure 1). The study site is located 2.3 kilometers (1.4 miles) south of a rocky headland at Devils Punch Bowl within a 7.5 kilometer (4.5 mile) stretch of beach which extends south to Yaquina Head. Cape Foulweather, a Miocene volcano forms the high headland north of Beverly Beach. The rubble-covered sea cliffs that border the coast consist of landslide blocks of the Astoria Formation (Snavely and MacLeod, 1971). The Astoria of middle Miocene age contains alternating beds of yellowish gray sandstone and dark-gray carbonaceous siltstone. The present beach was deposited on a wave-cut terrace in the Astoria Formation (Figure 27a).

Whaleback Island lies parallel to the coast about 730 meters (2400 feet) offshore from Beverly Beach. The island is made up of westward dipping Miocene pillow basalts of the Depoe Bay Formation which were laid down on top of the Astoria Formation. Whaleback Island which is about 400 meters long at low spring tide is almost awash at high spring tide. It acts like a detached breakwater and influences sedimentary processes on Beverly Beach.

A series of maps of Beverly Beach were made at 3 or 4 day intervals interspaced with maps of South Beach and Gleneden Beach. The study area is 475 meters (1500 feet) along the coast and extends from the base of the cliff for about 400 meters in a seaward direction (Figure 28). Seven profiles were surveyed across the beach at 76.2 meter (250 foot) intervals along the beach.

Six maps of Beverly Beach were selected from a series of 13 maps to show the changes in beach and bar configuration from July 6 through August 12, 1973 (Figure 28). On July 6, bar A formed an oval shaped bar 460 meters long with a runnel draining to the north and a large rip channel at the south end (Figure 28a). Bar B is connected to the shore near the south end of the study area. The beach forms a protuberance behind the bar which itself is centered behind Whaleback Island.

Between July 6 and 12, bar A migrated toward the shore and expanded to the south (Figure 28b). The rip channel at the south end of bar A was partially filled in by bar A and eroded the backside of bar B. Bar C formed at the north end of the study area as the trough was filled in behind the north end of bar A.

During the high wave activity between July 12 and 21, bar A expanded about 200 meters to the south and the rip channel shifted to the south end of the map (Figure 28c). On July 21, the rip channels at Beverly Beach cut diagonally across the beach to the southwest (Figure 27b). The rip channel with large megaripples on its bed is very similar to the rip channel formed behind bar C at South Beach (Figure 21c). Waves approaching from the north generated strong southward flowing longshore currents which formed rip channels draining to the south and southwest. Bar C at the north end of Beverly Beach also migrated shoreward between July 12 and 21.

During the low wave activity from July 21 to July 28, bars A and C continued to advance up the beach.

Figure 27a. Cliff and beach at Beverly Beach.

Figure 27b. Rip channels across Beverly Beach, July 21, 1973.

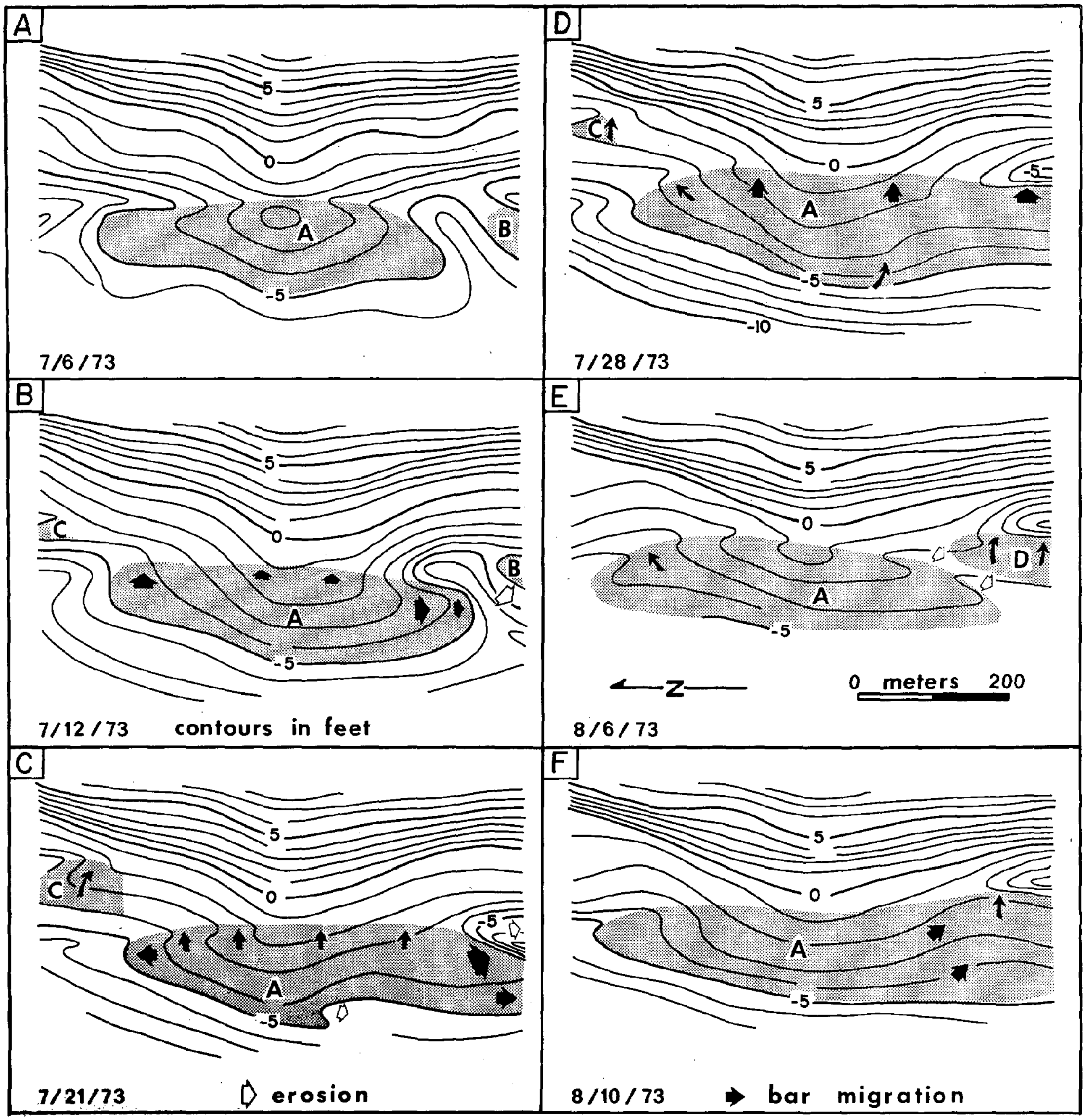



Figure 28. Sequence of maps showing southward movement of bar and rip channel at Beverly Beach, Oregon.

The rip channel at the south end of the map was considerably filled in by the advance of bar A (Figure 28d).

From July 28 through August 6, low wave activity, prevailed and bar migration continued. A secondary rip channel was cut across the south end of bar A forming bar D (Figure 28e). The shoreward edge of bar D continued to fill in the major rip channel at the south end of the map area. As the new rip channel was being excavated, the north end of bar A also advanced toward the shore, and bar C became welded to the beach. In the final map for Beverly Beach, bar A merged with bar D on August 12 (Figure 28f). The rip channel between bars A and D was closed off as bar A expanded to the south. The north end of bar A also filled in the runnel becoming welded to the beach.

In summary, the nearshore at Beverly Beach was dominated by a large oval bar which formed behind Whaleback rock. A well-developed rip channel was formed at the south end of the bar. During the summer from July 6 through August 10, the bar migrated toward the shore and expanded to the south. The rip channel at the south end of the bar moved about 400 meters to the south as the bar expanded. Minor bars formed at the north and south ends of the study area and advanced onto the beach.

## Gleneden Beach

Seven maps were made at Gleneden Beach from July 11 through August 11, 1973. The study area was located near the south end of Siletz Spit about 35 kilometers (21 miles) north of the Newport jetty (Figure 1). Siletz Spit extends to the north across the mouth of Siletz Bay, 7 kilometers north of the Government Point and about 20 kilometers south of Cascade Head. The study beach lies at the base of a sea cliff which is cut into the Miocene Astoria Formation.

The beach at Gleneden can be divided into 5 distinct zones seaward from the cliff; backbeach, berm, foreshore, trough and bar (Figure 31a). The backbeach extends for about 40 meters from the base of the cliff to the rise in the berm. The backbeach is 3.7 to 4.3 meters above mean sea level and 5.8 to 6.4 meters above the base of the foreshore. The flat backshore is surfaced by a wind lag deposit which closely resembles desert pavement. The seaward edge of the backbeach is marked by the berm which forms a continuous ridge about 0.3 meters above the backbeach. The berm was formed by wave overwash during spring high tides.

The foreshore at Gleneden Beach is about 55 meters (180 feet) wide and drops 5.5 meters (18 feet) to the trough giving a slope of 1:10 (Figure 31a). A series of cusps were developed on the foreshore with an average width of about 40 meters. The study area was laid out so that 3 cusps were included within the study site. A detailed analysis of the nature and development of the cusps was undertaken by one of the student field assistants from Williams College (McTigue, 1974).

The bar and trough configuration at Gleneden Beach is part of a large scale rhythmic topography (Figure 29b). The bars are spaced at 300 meter intervals along the shore with troughs draining at the south ends of the bars. When the bars are exposed at low spring tide, the troughs are about 1 meter under water. At mid-tide, strong rip currents develop within the bar and trough system, while at high-tide, steady longshore currents flow parallel to the steep foreshore.

The study site at Gleneden Beach was established to determine the migration rate of the large cusps. During the 30 days of observation, the size and position of the cusps did not measurably change, even though the cusps actively influenced the wave run-up on the beach. The cusp spacing may have been related to larger waves within the area before the study started.

Between July 30 and August 11, a triangular shaped bar moved across the trough to the base of the foreshore (Figures 31 and 32). On July 30, the crest of the bar was 31 meters (102 feet) seaward of the base of the foreshore and 1.4 meters below mean sea level. On August 3, the bar migrated about 25 meters to the south and 10 meters toward the shore. The erosion and deposition map for August 3 (Figure 31c) shows a broad area of deposition shoreward and to the south of the bar filling in the trough. Erosion took place on the seaward edge of the bar and on the foreshore. A scarp developed on the upper foreshore as the lower foreshore was eroded (Figure 30b). From August 3 to August 11, the bar continued to advance toward the shore and fill in the trough to the south (Figure 32). The total distance which the bar moved from July 30 to August 11 was about 45 meters (150 feet) to the south and 30 meters toward the shore. On August 3, the leading edge of the bar was welded on to the base of the foreshore (Figure 32b). A channel was eroded on the north side of the bar and filled in on the south side. Deposition took place on the foreshore and in the trough in front of the bar with erosion on the back bar and in the channel to the north of the bar (Figure 32c).

Figure 29a. Study site at Gleneden Beach.

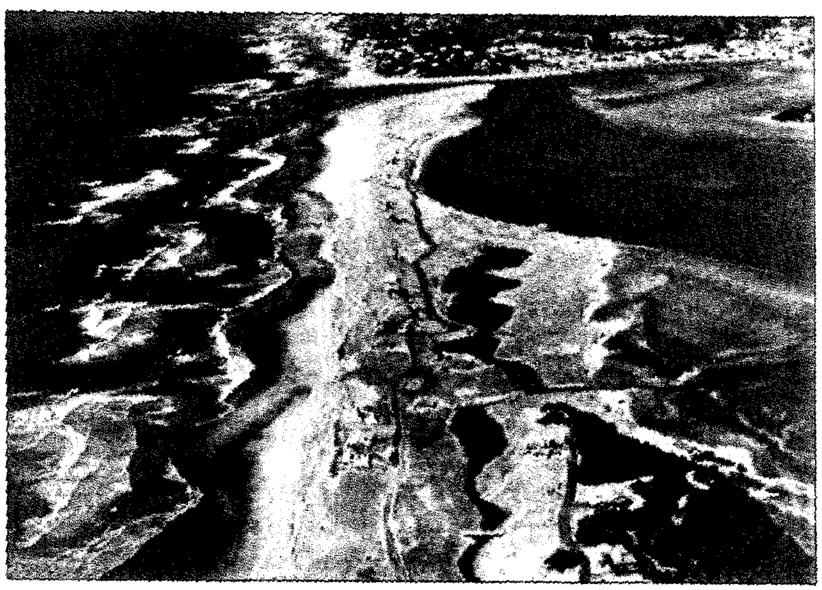


Figure 29b. Rhythmic topography on Siletz spit north of Gleneden Beach.

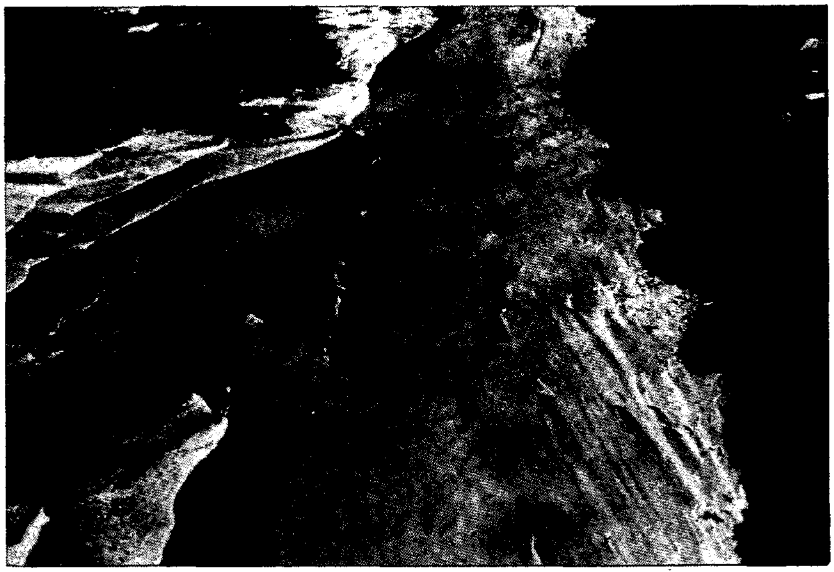


Figure 30 a. Sand bar at Gleneden Beach, August 2, 1973.

Figure 30b. Erosion scarp on Gleneden Beach, July, 1973.

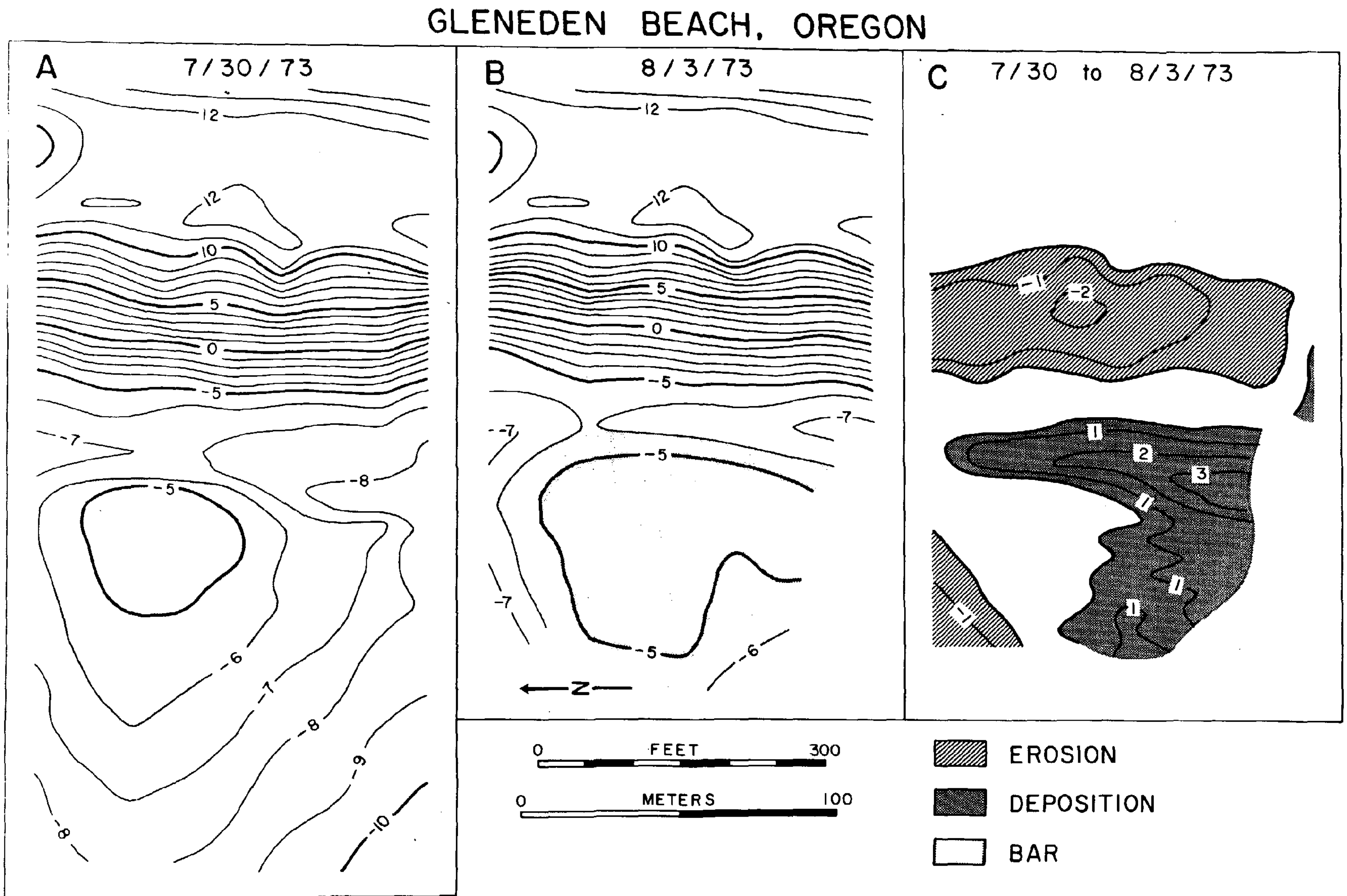



Figure 31. Topographic maps for (A) July 30 and (B) August 3, and (C) erosion and deposition map for July 30 to August 3, 1973 at Gleneden Beach, Oregon.

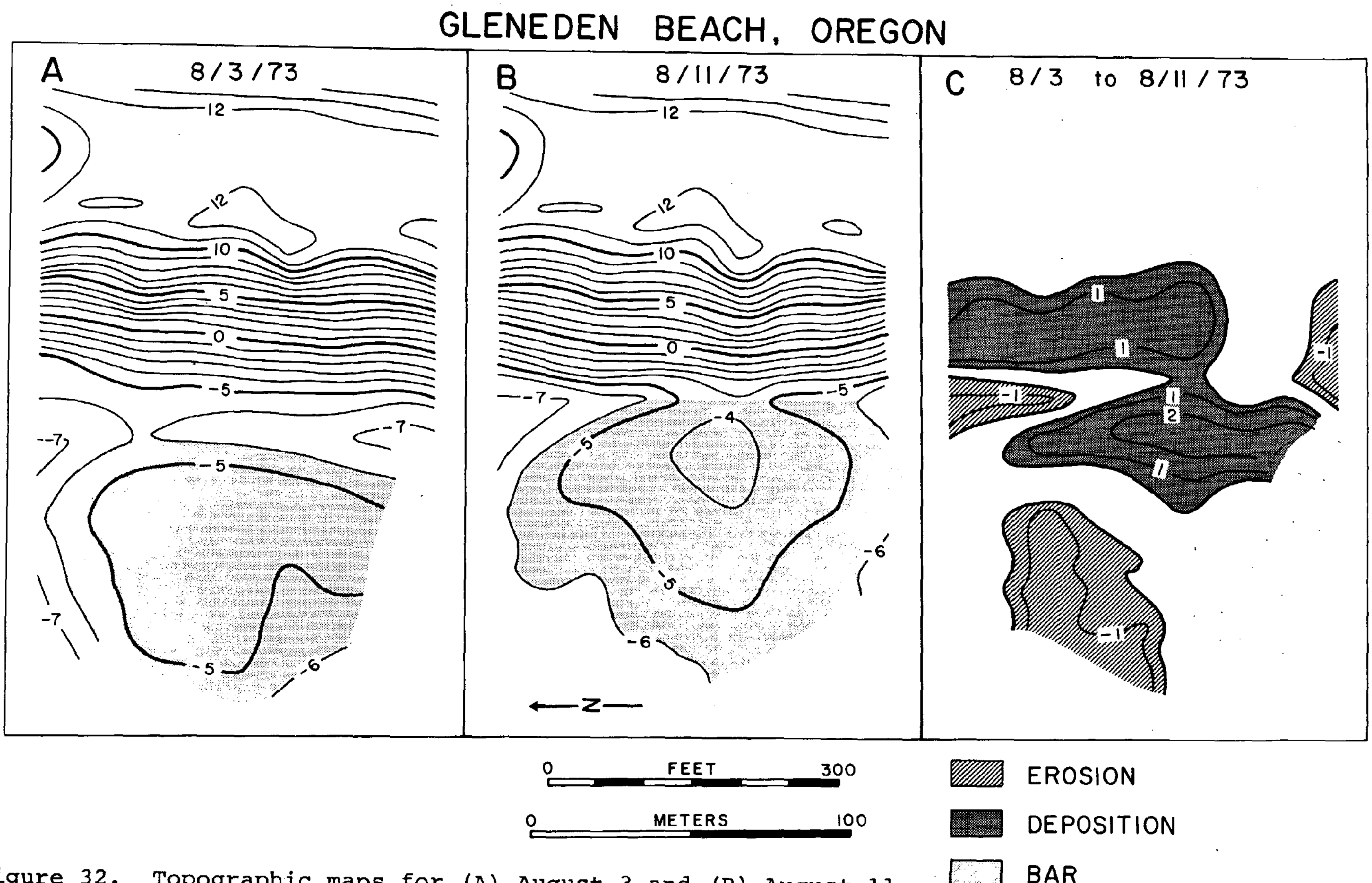



Figure 32. Topographic maps for (A) August 3 and (B) August 11, and (C) erosion and deposition map for August 3 to August 11, 1973 at Gleneden Beach, Oregon.

In summary, Gleneden Beach has a well developed backbeach, berm, foreshore, trough and bar. The backbeach is well-above sea level with a steep foreshore leading down to the bar and trough topography. Two levels of rhythmic topography are present on Gleneden Beach, large cusps on the foreshore with a wavelength of about 40 meters and rhythmic bar and trough topography with a wavelength of about 300 meters.

## SUMMARY AND CONCLUSIONS

A 45-day time series study was completed during July and August, 1973 on the central Oregon coast. Weather and wave data were collected at Oregon State University Marine Science Center, Newport, Oregon. Profiles were made across the beach and into the surf zone at South Beach, Beverly Beach and Gleneden Beach. Topographic maps and maps of erosion and deposition were made at three or four day intervals for each of the beaches. The following conclusions are based on the 45-day study.

1. During the summer, the weather on the Oregon coast is dominated by the East Pacific Subtropical High located a few hundred kilometers off the coast. Clockwise circulation around the high produces steady north winds along the shore.

2. The peaks in the breaker height curve are directly related to the lows in the barometric pressure curve, but are not directly correlated with the wind. Therefore, the waves are generated by local winds circulating around offshore lows in barometric pressure, but not to the strong north winds that parallel the coast.

3. The nearshore currents within the surf zone are controlled by rip currents with superimposed longshore currents. The rip currents conform to the bars and troughs in the nearshore zone. The speed and direction of the longshore current are directly related to the longshore component of the wind with a 2 to 3 day time lag for the direction reversal.

4. Sand bars formed below mean sea level advance across the beach during low energy conditions. The rate of shoreward advance varies from 1 to 5 meters/day. Under the influence of strong southward flowing longshore currents, the bars migrate to the south at 10 to 15 meters/day. When the bar reaches the mid-tide level, it becomes stationary or welded to the beach.

5. Rip channels are best formed during ebb tides with intermediate to high waves when wave and current energy is concentrated in the mid-tide zone. The rip channels are destroyed when bars advance across the channels during low energy conditions.

6. The beaches on the Oregon coast are basically accretionary during the summer when the sand lost to winter storms is returned to the beach.

## REFERENCES CITED


Abele, R. W., 1973, Detailed analysis of short-term variations in beach morphology (and concurrent dynamic processes) for summer and winter periods, 1971-72, Plum Island, Massachusetts. Master's thesis, University of Massachusetts, 166 p.

Bascom, W., 1951, The relationship between sand size and beach face slope, Amer. Geophys. Union Trans., vol. 32, pp. 866-874.

Clifton, H. E., Hunter, R. E., and Phillips, R. L., 1971, Depositional structures and processes in the non-barred high-energy nearshore, Jour. Sed. Petrology, v. 41, pp. 651-670.

Creech, C., 1973, Wave climatology of the central Oregon coast, Technical Report NOAA Sea Grant project 04-3-158-4. OSU Marine Science Center, Newport, Oregon, 19 p.

Davis, R. A., Jr., and Fox, W. T., 1971, Beach and nearshore dynamics in eastern Lake Michigan: Tech. Rept. No. 4, O.N.R. Contract 388-092, Williams College, 145 p.

Davis, R. A., Jr., and Fox, W. T., 1972, Coastal dynamics along Mustang Island, Texas, Tech. Rept. No. 9, O.N.R. Contract 388-092, Williams College, 68 p.

Dolan, R., Ferm, J. C., and McArthur, D. S., 1969, Measurements of beach process variables, Outer Banks, North Carolina, O.N.R. Tech. Rept. Coastal Studies Institute, Contract 388-002, 79 p.

Emery, K. O., 1961, A simple method of measuring beach profiles, Limnology and Oceanography, v. 6, pp. 90-93.

Fox, W. T., and Davis, R. A., Jr., 1970, Fourier analysis of weather and wave data from Lake Michigan: O.N.R. Tech. Rept. No. 1, Contract 388-092, Williams College, 47 p.

Fox, W. T., and Davis, R. A., Jr., 1971a, Fourier analysis of weather and wave data from Holland, Michigan, July, 1970: O.N.R. Tech. Rept. No. 3, Contract 388-092, Williams College, 79 p.

Fox, W. T., and Davis, R. A., Jr., 1971b, Computer simulation model of coastal processes in eastern Lake Michigan, O.N.R. Tech. Rept. No. 5, Contract 388-092, Williams College, 114 p.

Fox, W. T., and Davis, R. A., Jr., 1973a, Simulation model for storm cycles and beach erosion on Lake Michigan, Geol. Soc. of America Bull., v. 84, pp. 1769-1790.

Fox, W. T., and Davis, R. A., Jr., 1973b, Coastal processes and beach dynamics at Sheboygan, Wisconsin, July, 1972, O.N.R. Tech. Rept. No. 10, Contract 388-092, Williams College, 94 p.

Frye, D. E., Pond, S., and Elliott, W. P., 1972, Note on the kinetic energy spectrum of coastal winds, Monthly Weather Review, v. 100, pp. 671-673.

Harrison, W., 1969, Empirical equations for foreshore changes over a tidal cycle, Marine Geology 7(6): 529-551.

Harrison, W., and Krumbein, W. C., 1964, Interactions of the beach-ocean-atmosphere system at Virginia Beach, Virginia, Technical Memorandum No. 7, Coastal Engineering Research Center, 52 p.

Harrison, W., Rayfield, E. W., Boon, J. D., III, Reynolds, G., Grant, J. B., and Tyler, D., 1969, A times series from the beach environment, LASIL Contribution No. 12, 94 p.

King, C. A. M., 1972, Beaches and coasts, Saint Martins Press, New York, 570 p.

Longuet-Higgins, M. S., 1950, A theory of the origin of microseisms, Phil. Trans. Roy Soc. (London) Serial A, 243, pp. 1-35.

Lund, E. H., 1972, Coastal landforms between Yachats and Newport, Oregon, The ORE BIN, v. 34, pp. 73-91.

McTigue, D. F., 1974, Theoretical approach to mechanisms of beach cusps formation, Honors thesis, Williams College, 131 p.

Rottman, C. J. F., 1973, Surf zone shape changes in quartz grains on Pocket Beaches, Cape Arago, Oregon, Jour. Sed. Petrology, v. 43, pp. 188-199.

Snavely, P. D., Jr., and MacLeod, N. S., 1971, Visitors guide to the geology of the coastal area near Beverly Beach State Park, Oregon, The ORE BIN,

v. 33, pp. 85-105.

Sonu, C. J., 1972, Field observation of nearshore circulation and meandering currents, Jour. Geophys. Res., vol. 77, pp. 3232-3247.

Sonu, C. J., and van Beck, J. L., 1971, Systematic changes on the Outer Banks, North Carolina, Jour. Geol., v. 79, pp. 416-425.

Sonu, C. J., and James, W. R., 1973, A Markov model for beach profile changes, Jour. Geophys. Res., v. 78, pp. 1462-1471.

Sonu, C. J., McCloy, J. M., and McArthur, D. S., 1966, Longshore currents and nearshore topographics, Proc. Xth Conference on Coastal Engineering, Council on Wave Research, pp. 525-549.

Sonu, C. J., and Russell, R. J., 1966, Topographic changes in the surf zone profile, Proc. Xth Conference on Coastal Engineering, Council on Wave Research, pp. 502-524.

# APPENDIX I. OBSERVED DATA

Weather and tide data were extracted from continuous records at the Oregon State University Marine Science Center at one hour intervals from July 1 through August 14, 1973. Wave data was derived from microseismograph records at the Oregon State University Marine Science Center at 6 hour intervals for the same dates. Longshore and rip current data was collected twice daily from July 7 through August 11 in the surf at the South Beach study site. Additional readings were taken when the survey crew was at South Beach at 1400. Variables measured include the following:

BP - Barometric Pressure

WS - Wind Speed

WD - Wind Direction

TA - Air Temperature

HUM - Humidity

TIDE - Tide Level

T - Wave Period

H3 - Significant Wave Height

H10 - Breaker Height

AZI - Current Azimuth

SPEED - Current Velocity

ON - Onshore Current

AL - Alongshore Current

WEATHER AND TIDE DATA

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/ 1/73 | 1 | 1020.0 | 2 | 30 | 51 | 92 | 8.9 |
| 7/ 1/73 | 2 | 1019.9 | 0 | 110 | 50 | 91 | 7.0 |
| 7/ 1/73 | 3 | 1019.5 | 0 | 70 | 48 | 91 | 2.6 |
| 7/ 1/73 | 4 | 1019.6 | 3 | 75 | 47 | 92 | 1.7 |
| 7/ 1/73 | 5 | 1019.4 | 2 | 95 | 46 | 92 | -1.1 |
| 7/ 1/73 | 6 | 1019.0 | 5 | 75 | 47 | 92 | -2.9 |
| 7/ 1/73 | 7 | 1018.9 | 4 | 90 | 50 | 92 | -3.4 |
| 7/ 1/73 | 8 | 1018.8 | 2 | 20 | 54 | 90 | -2.3 |
| 7/ 1/73 | 9 | 1018.5 | 4 | 330 | 58 | 86 | -0.7 |
| 7/ 1/73 | 10 | 1018.2 | 8 | 350 | 59 | 79 | 1.6 |
| 7/ 1/73 | 11 | 1017.2 | 11 | 345 | 60 | 62 | 4.0 |
| 7/ 1/73 | 12 | 1016.8 | 12 | 345 | 61 | 57 | 5.8 |
| 7/ 1/73 | 13 | 1016.0 | 14 | 345 | 61 | 54 | 7.2 |
| 7/ 1/73 | 14 | 1015.6 | 16 | 350 | 60 | 54 | 7.5 |
| 7/ 1/73 | 15 | 1015.0 | 17 | 350 | 60 | 56 | 6.4 |
| 7/ 1/73 | 16 | 1014.7 | 17 | 350 | 61 | 58 | 5.0 |
| 7/ 1/73 | 17 | 1014.3 | 15 | 350 | 59 | 65 | 3.5 |
| 7/ 1/73 | 18 | 1014.0 | 15 | 350 | 58 | 67 | 2.4 |
| 7/ 1/73 | 19 | 1014.0 | 12 | 360 | 56 | 74 | 2.0 |
| 7/ 1/73 | 20 | 1014.0 | 10 | 355 | 54 | 82 | 2.9 |
| 7/ 1/73 | 21 | 1014.3 | 8 | 345 | 53 | 84 | 4.2 |
| 7/ 1/73 | 22 | 1014.4 | 7 | 355 | 51 | 89 | 6.0 |
| 7/ 1/73 | 23 | 1014.3 | 1 | 60 | 51 | 89 | 7.8 |
| 7/ 1/73 | 24 | 1014.5 | 0 | 210 | 48 | 89 | 9.2 |
| 7/ 2/73 | 1 | 1014.5 | 2 | 195 | 47 | 89 | 9.6 |
| 7/ 2/73 | 2 | 1014.7 | 2 | 170 | 46 | 89 | 8.6 |
| 7/ 2/73 | 3 | 1014.7 | 0 | 105 | 47 | 89 | 6.7 |
| 7/ 2/73 | 4 | 1015.0 | 0 | 90 | 48 | 89 | 4.2 |
| 7/ 2/73 | 5 | 1015.1 | 2 | 80 | 49 | 89 | 1.2 |
| 7/ 2/73 | 6 | 1015.2 | 1 | 105 | 50 | 89 | -1.1 |
| 7/ 2/73 | 7 | 1015.4 | 3 | 125 | 52 | 88 | -2.7 |
| 7/ 2/73 | 8 | 1016.0 | 1 | 10 | 57 | 80 | -2.8 |
| 7/ 2/73 | 9 | 1017.0 | 3 | 275 | 58 | 77 | -1.6 |
| 7/ 2/73 | 10 | 1017.2 | 2 | 280 | 59 | 72 | 0.4 |
| 7/ 2/73 | 11 | 1017.6 | 3 | 230 | 61 | 64 | 2.7 |
| 7/ 2/73 | 12 | 1018.0 | 4 | 240 | 62 | 63 | 4.8 |
| 7/ 2/73 | 13 | 1018.3 | 5 | 235 | 61 | 64 | 6.7 |
| 7/ 2/73 | 14 | 1018.4 | 6 | 240 | 62 | 64 | 7.7 |
| 7/ 2/73 | 15 | 1018.5 | 6 | 240 | 61 | 63 | 7.6 |
| 7/ 2/73 | 16 | 1018.5 | 6 | 255 | 61 | 67 | 6.3 |
| 7/ 2/73 | 17 | 1018.5 | 3 | 230 | 60 | 66 | 4.8 |
| 7/ 2/73 | 18 | 1018.4 | 3 | 225 | 60 | 68 | 3.2 |
| 7/ 2/73 | 19 | 1018.4 | 3 | 215 | 58 | 72 | 2.0 |
| 7/ 2/73 | 20 | 1018.5 | 3 | 195 | 56 | 80 | 1.8 |
| 7/ 2/73 | 21 | 1018.9 | 2 | 190 | 53 | 86 | 2.7 |
| 7/ 2/73 | 22 | 1019.0 | 1 | 65 | 52 | 88 | 4.1 |
| 7/ 2/73 | 23 | 1018.9 | 1 | 75 | 50 | 90 | 5.8 |
| 7/ 2/73 | 24 | 1019.0 | 1 | 60 | 48 | 90 | 7.6 |
| 7/ 3/73 | 1 | 1019.1 | 1 | 65 | 50 | 90 | 8.7 |
| 7/ 3/73 | 2 | 1019.2 | 2 | 70 | 51 | 90 | 9.1 |
| 7/ 3/73 | 3 | 1019.1 | 2 | 75 | 52 | 90 | 8.0 |
| 7/ 3/73 | 4 | 1019.1 | 2 | 75 | 51 | 90 | 6.1 |
| 7/ 3/73 | 5 | 1019.2 | 2 | 80 | 51 | 90 | 3.7 |
| 7/ 3/73 | 6 | 1019.6 | 2 | 75 | 52 | 90 | 0.9 |
| 7/ 3/73 | 7 | 1020.0 | 3 | 40 | 56 | 80 | -1.3 |
| 7/ 3/73 | 8 | 1020.3 | 3 | 225 | 60 | 74 | -2.4 |
| 7/ 3/73 | 9 | 1021.0 | 4 | 225 | 62 | 70 | -2.1 |
| 7/ 3/73 | 10 | 1021.0 | 3 | 240 | 62 | 65 | -0.7 |
| 7/ 3/73 | 11 | 1021.1 | 3 | 270 | 64 | 67 | 1.3 |
| 7/ 3/73 | 12 | 1021.1 | 3 | 290 | 65 | 64 | 3.6 |
| 7/ 3/73 | 13 | 1020.0 | 5 | 285 | 65 | 64 | 5.6 |
| 7/ 3/73 | 14 | 1021.7 | 4 | 270 | 64 | 68 | 7.3 |
| 7/ 3/73 | 15 | 1022.0 | 4 | 240 | 63 | 69 | 8.0 |
| 7/ 3/73 | 16 | 1022.0 | 1 | 320 | 62 | 73 | 7.5 |
| 7/ 3/73 | 17 | 1022.0 | 1 | 220 | 61 | 75 | 6.1 |
| 7/ 3/73 | 18 | 1022.0 | 2 | 210 | 60 | 79 | 4.4 |
| 7/ 3/73 | 19 | 1022.2 | 2 | 200 | 60 | 82 | 2.9 |
| 7/ 3/73 | 20 | 1022.2 | 2 | 195 | 60 | 82 | 1.7 |
| 7/ 3/73 | 21 | 1022.9 | 1 | 195 | 59 | 83 | 1.6 |
| 7/ 3/73 | 22 | 1023.0 | 2 | 210 | 59 | 85 | 2.6 |
| 7/ 3/73 | 23 | 1023.2 | 1 | 225 | 58 | 85 | 4.0 |
| 7/ 3/73 | 24 | 1023.2 | 0 | 180 | 58 | 85 | 5.6 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/ 4/73 | 1 | 1023.1 | 1 | 190 | 58 | 85 | 7.1 |
| 7/ 4/73 | 2 | 1023.0 | 0 | 195 | 57 | 86 | 8.1 |
| 7/ 4/73 | 3 | 1022.9 | 0 | 150 | 57 | 87 | 8.3 |
| 7/ 4/73 | 4 | 1022.9 | 0 | 215 | 56 | 90 | 7.2 |
| 7/ 4/73 | 5 | 1023.0 | 0 | 190 | 57 | 89 | 5.5 |
| 7/ 4/73 | 6 | 1023.0 | 0 | 175 | 58 | 89 | 3.2 |
| 7/ 4/73 | 7 | 1022.9 | 2 | 225 | 59 | 84 | 0.8 |
| 7/ 4/73 | 8 | 1023.1 | 2 | 230 | 60 | 82 | -0.9 |
| 7/ 4/73 | 9 | 1023.2 | 3 | 240 | 62 | 79 | -1.5 |
| 7/ 4/73 | 10 | 1023.2 | 4 | 235 | 63 | 77 | -0.9 |
| 7/ 4/73 | 11 | 1023.3 | 5 | 240 | 64 | 70 | 0.4 |
| 7/ 4/73 | 12 | 1023.4 | 4 | 235 | 63 | 87 | 2.3 |
| 7/ 4/73 | 13 | 1023.2 | 6 | 220 | 65 | 73 | 4.5 |
| 7/ 4/73 | 14 | 1023.1 | 4 | 250 | 61 | 90 | 6.3 |
| 7/ 4/73 | 15 | 1023.0 | 8 | 300 | 60 | 90 | 7.6 |
| 7/ 4/73 | 16 | 1023.0 | 10 | 310 | 57 | 90 | 7.9 |
| 7/ 4/73 | 17 | 1022.8 | 4 | 315 | 58 | 84 | 7.1 |
| 7/ 4/73 | 18 | 1022.3 | 3 | 330 | 58 | 82 | 5.6 |
| 7/ 4/73 | 19 | 1022.3 | 4 | 10 | 58 | 85 | 4.1 |
| 7/ 4/73 | 20 | 1021.5 | 1 | 250 | 57 | 84 | 2.4 |
| 7/ 4/73 | 21 | 1021.5 | 0 | 290 | 57 | 83 | 1.4 |
| 7/ 4/73 | 22 | 1021.5 | 5 | 305 | 57 | 78 | 1.3 |
| 7/ 4/73 | 23 | 1021.3 | 6 | 310 | 57 | 78 | 2.1 |
| 7/ 4/73 | 24 | 1021.0 | 1 | 15 | 56 | 89 | 3.4 |
| 7/ 5/73 | 1 | 1020.9 | 0 | 270 | 56 | 89 | 4.9 |
| 7/ 5/73 | 2 | 1020.6 | 0 | 140 | 55 | 90 | 6.2 |
| 7/ 5/73 | 3 | 1020.2 | 0 | 90 | 55 | 90 | 7.1 |
| 7/ 5/73 | 4 | 1020.0 | 0 | 30 | 54 | 90 | 7.3 |
| 7/ 5/73 | 5 | 1019.9 | 1 | 190 | 55 | 90 | 6.2 |
| 7/ 5/73 | 6 | 1019.9 | 4 | 330 | 55 | 89 | 4.7 |
| 7/ 5/73 | 7 | 1019.8 | 5 | 10 | 56 | 84 | 2.8 |
| 7/ 5/73 | 8 | 1019.3 | 1 | 350 | 59 | 76 | 0.9 |
| 7/ 5/73 | 9 | 1019.0 | 1 | 340 | 62 | 60 | -0.2 |
| 7/ 5/73 | 10 | 1018.7 | 5 | 295 | 61 | 58 | -0.4 |
| 7/ 5/73 | 11 | 1018.6 | 10 | 315 | 60 | 69 | 0.2 |
| 7/ 5/73 | 12 | 1018.2 | 6 | 335 | 62 | 66 | 1.7 |
| 7/ 5/73 | 13 | 1018.0 | 8 | 325 | 62 | 65 | 3.6 |
| 7/ 5/73 | 14 | 1017.3 | 5 | 340 | 63 | 59 | 5.4 |
| 7/ 5/73 | 15 | 1017.1 | 3 | 325 | 63 | 60 | 7.1 |
| 7/ 5/73 | 16 | 1016.9 | 5 | 320 | 62 | 58 | 8.1 |
| 7/ 5/73 | 17 | 1016.2 | 6 | 330 | 61 | 58 | 8.1 |
| 7/ 5/73 | 18 | 1016.0 | 3 | 325 | 59 | 64 | 7.1 |
| 7/ 5/73 | 19 | 1015.9 | 4 | 325 | 58 | 69 | 5.7 |
| 7/ 5/73 | 20 | 1015.3 | 2 | 350 | 57 | 70 | 4.1 |
| 7/ 5/73 | 21 | 1015.5 | 0 | 350 | 57 | 72 | 2.6 |
| 7/ 5/73 | 22 | 1015.4 | 0 | 210 | 56 | 79 | 1.6 |
| 7/ 5/73 | 23 | 1015.3 | 2 | 220 | 55 | 84 | 1.4 |
| 7/ 5/73 | 24 | 1015.2 | 4 | 190 | 56 | 84 | 2.2 |
| 7/ 6/73 | 1 | 1015.1 | 1 | 165 | 56 | 85 | 3.2 |
| 7/ 6/73 | 2 | 1015.0 | 2 | 170 | 55 | 85 | 4.6 |
| 7/ 6/73 | 3 | 1015.0 | 4 | 170 | 54 | 89 | 5.7 |
| 7/ 6/73 | 4 | 1015.1 | 2 | 150 | 54 | 89 | 4.4 |
| 7/ 6/73 | 5 | 1015.2 | 2 | 120 | 55 | 89 | 4.5 |
| 7/ 6/73 | 6 | 1015.3 | 0 | 180 | 56 | 85 | 5.7 |
| 7/ 6/73 | 7 | 1016.0 | 6 | 200 | 58 | 78 | 4.5 |
| 7/ 6/73 | 8 | 1016.0 | 6 | 145 | 60 | 68 | 2.8 |
| 7/ 6/73 | 9 | 1016.2 | 10 | 230 | 60 | 70 | 1.6 |
| 7/ 6/73 | 10 | 1016.8 | 12 | 210 | 62 | 65 | 0.3 |
| 7/ 6/73 | 11 | 1017.0 | 10 | 205 | 63 | 60 | 0.9 |
| 7/ 6/73 | 12 | 1017.2 | 13 | 230 | 62 | 62 | 1.6 |
| 7/ 6/73 | 13 | 1017.7 | 9 | 225 | 63 | 63 | 2.9 |
| 7/ 6/73 | 14 | 1017.9 | 11 | 210 | 64 | 56 | 4.7 |
| 7/ 6/73 | 15 | 1017.7 | 7 | 215 | 63 | 68 | 6.1 |
| 7/ 6/73 | 16 | 1018.0 | 7 | 225 | 64 | 68 | 7.5 |
| 7/ 6/73 | 17 | 1018.0 | 2 | 220 | 63 | 70 | 8.0 |
| 7/ 6/73 | 18 | 1017.9 | 4 | 225 | 62 | 69 | 7.8 |
| 7/ 6/73 | 19 | 1017.8 | 3 | 205 | 60 | 74 | 6.9 |
| 7/ 6/73 | 20 | 1017.7 | 3 | 205 | 57 | 84 | 5.5 |
| 7/ 6/73 | 21 | 1017.3 | 2 | 240 | 55 | 89 | 4.0 |
| 7/ 6/73 | 22 | 1017.2 | 2 | 100 | 54 | 90 | 2.5 |
| 7/ 6/73 | 23 | 1017.2 | 1 | 160 | 52 | 90 | 1.6 |
| 7/ 6/73 | 24 | 1016.9 | 0 | 190 | 52 | 90 | 1.3 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/ 7/73 | 1 | 1016.6 | 4 | 95 | 50 | 90 | 1.9 |
| 7/ 7/73 | 2 | 1016.4 | 3 | 90 | 51 | 90 | 2.8 |
| 7/ 7/73 | 3 | 1016.4 | 3 | 95 | 51 | 90 | 4.1 |
| 7/ 7/73 | 4 | 1016.3 | 4 | 85 | 50 | 90 | 5.1 |
| 7/ 7/73 | 5 | 1016.5 | 5 | 90 | 51 | 90 | 5.7 |
| 7/ 7/73 | 6 | 1016.5 | 4 | 90 | 54 | 90 | 5.7 |
| 7/ 7/73 | 7 | 1016.4 | 4 | 55 | 58 | 82 | 5.1 |
| 7/ 7/73 | 8 | 1016.4 | 1 | 190 | 60 | 71 | 4.1 |
| 7/ 7/73 | 9 | 1016.5 | 5 | 215 | 61 | 56 | 3.0 |
| 7/ 7/73 | 10 | 1016.6 | 5 | 260 | 62 | 57 | 2.1 |
| 7/ 7/73 | 11 | 1016.5 | 3 | 280 | 64 | 46 | 1.7 |
| 7/ 7/73 | 12 | 1016.5 | 4 | 275 | 65 | 47 | 1.8 |
| 7/ 7/73 | 13 | 1016.5 | 6 | 240 | 64 | 50 | 2.7 |
| 7/ 7/73 | 14 | 1016.6 | 5 | 240 | 63 | 56 | 3.9 |
| 7/ 7/73 | 15 | 1016.6 | 6 | 245 | 64 | 56 | 5.3 |
| 7/ 7/73 | 16 | 1016.3 | 6 | 225 | 63 | 56 | 6.7 |
| 7/ 7/73 | 17 | 1016.1 | 6 | 215 | 62 | 60 | 7.7 |
| 7/ 7/73 | 18 | 1016.0 | 7 | 210 | 61 | 60 | 8.1 |
| 7/ 7/73 | 19 | 1016.0 | 7 | 205 | 60 | 60 | 7.7 |
| 7/ 7/73 | 20 | 1015.9 | 8 | 200 | 57 | 74 | 6.5 |
| 7/ 7/73 | 21 | 1016.0 | 5 | 185 | 57 | 79 | 5.2 |
| 7/ 7/73 | 22 | 1016.0 | 7 | 180 | 58 | 78 | 3.7 |
| 7/ 7/73 | 23 | 1016.0 | 9 | 190 | 58 | 78 | 2.3 |
| 7/ 7/73 | 24 | 1016.1 | 8 | 180 | 57 | 88 | 1.5 |
| 7/ 8/73 | 1 | 1016.1 | 5 | 180 | 56 | 88 | 1.2 |
| 7/ 8/73 | 2 | 1016.1 | 3 | 130 | 57 | 88 | 1.6 |
| 7/ 8/73 | 3 | 1016.2 | 2 | 160 | 57 | 88 | 2.5 |
| 7/ 8/73 | 4 | 1016.5 | 4 | 225 | 57 | 89 | 3.7 |
| 7/ 8/73 | 5 | 1017.0 | 3 | 205 | 56 | 90 | 4.6 |
| 7/ 8/73 | 6 | 1017.2 | 0 | 180 | 57 | 90 | 5.2 |
| 7/ 8/73 | 7 | 1017.5 | 4 | 180 | 57 | 90 | 5.4 |
| 7/ 8/73 | 8 | 1018.1 | 6 | 210 | 58 | 90 | 5.2 |
| 7/ 8/73 | 9 | 1018.8 | 11 | 205 | 58 | 90 | 4.5 |
| 7/ 8/73 | 10 | 1019.2 | 12 | 200 | 61 | 88 | 3.7 |
| 7/ 8/73 | 11 | 1020.0 | 12 | 210 | 61 | 87 | 2.9 |
| 7/ 8/73 | 12 | 1020.5 | 7 | 225 | 64 | 71 | 2.7 |
| 7/ 8/73 | 13 | 1021.0 | 7 | 210 | 63 | 64 | 2.7 |
| 7/ 8/73 | 14 | 1021.0 | 5 | 215 | 64 | 68 | 3.6 |
| 7/ 8/73 | 15 | 1021.0 | 5 | 220 | 65 | 64 | 4.6 |
| 7/ 8/73 | 16 | 1021.0 | 6 | 220 | 65 | 62 | 5.8 |
| 7/ 8/73 | 17 | 1021.0 | 4 | 250 | 64 | 64 | 6.9 |
| 7/ 8/73 | 18 | 1021.0 | 3 | 275 | 63 | 70 | 7.8 |
| 7/ 8/73 | 19 | 1021.0 | 3 | 295 | 62 | 69 | 7.9 |
| 7/ 8/73 | 20 | 1021.0 | 2 | 270 | 59 | 85 | 7.4 |
| 7/ 8/73 | 21 | 1021.4 | 2 | 165 | 57 | 90 | 5.3 |
| 7/ 8/73 | 22 | 1021.6 | 1 | 90 | 56 | 90 | 4.9 |
| 7/ 8/73 | 23 | 1021.6 | 2 | 75 | 57 | 90 | 3.5 |
| 7/ 8/73 | 24 | 1021.6 | 1 | 90 | 57 | 90 | 2.0 |
| 7/ 9/73 | 1 | 1021.8 | 1 | 90 | 57 | 90 | 1.0 |
| 7/ 9/73 | 2 | 1021.8 | 5 | 95 | 56 | 90 | 0.8 |
| 7/ 9/73 | 3 | 1021.8 | 4 | 100 | 56 | 90 | 1.1 |
| 7/ 9/73 | 4 | 1022.0 | 4 | 105 | 55 | 90 | 1.9 |
| 7/ 9/73 | 5 | 1022.0 | 2 | 90 | 54 | 90 | 3.0 |
| 7/ 9/73 | 6 | 1022.1 | 5 | 90 | 56 | 89 | 4.1 |
| 7/ 9/73 | 7 | 1022.1 | 4 | 85 | 58 | 84 | 4.9 |
| 7/ 9/73 | 8 | 1022.1 | 2 | 10 | 61 | 72 | 5.2 |
| 7/ 9/73 | 9 | 1022.0 | 10 | 350 | 65 | 59 | 5.3 |
| 7/ 9/73 | 10 | 1021.8 | 11 | 350 | 65 | 60 | 4.8 |
| 7/ 9/73 | 11 | 1021.4 | 13 | 350 | 66 | 60 | 4.3 |
| 7/ 9/73 | 12 | 1021.0 | 14 | 345 | 66 | 61 | 3.7 |
| 7/ 9/73 | 13 | 1020.2 | 15 | 350 | 67 | 60 | 3.4 |
| 7/ 9/73 | 14 | 1019.8 | 17 | 345 | 68 | 58 | 3.7 |
| 7/ 9/73 | 15 | 1019.3 | 18 | 345 | 67 | 60 | 4.2 |
| 7/ 9/73 | 16 | 1018.1 | 18 | 345 | 66 | 60 | 5.1 |
| 7/ 9/73 | 17 | 1017.7 | 17 | 345 | 66 | 61 | 6.2 |
| 7/ 9/73 | 18 | 1017.0 | 14 | 0 | 66 | 64 | 7.2 |
| 7/ 9/73 | 19 | 1016.8 | 12 | 350 | 64 | 70 | 8.0 |
| 7/ 9/73 | 20 | 1016.7 | 11 | 355 | 60 | 82 | 8.1 |
| 7/ 9/73 | 21 | 1016.8 | 6 | 10 | 58 | 84 | 7.5 |
| 7/ 9/73 | 22 | 1017.0 | 6 | 330 | 58 | 87 | 6.3 |
| 7/ 9/73 | 23 | 1017.2 | 4 | 345 | 57 | 88 | 4.8 |
| 7/ 9/73 | 24 | 1017.5 | 0 | 5 | 57 | 80 | 3.2 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/10/73 | 1 | 1017.9 | 0 | 280 | 56 | 88 | 1.7 |
| 7/10/73 | 2 | 1018.1 | 2 | 195 | 55 | 90 | 0.7 |
| 7/10/73 | 3 | 1019.0 | 5 | 315 | 57 | 90 | -0.4 |
| 7/10/73 | 4 | 1019.3 | 3 | 320 | 58 | 87 | -0.2 |
| 7/10/73 | 5 | 1020.0 | 2 | 300 | 58 | 85 | 1.6 |
| 7/10/73 | 6 | 1020.9 | 0 | 220 | 58 | 86 | 2.7 |
| 7/10/73 | 7 | 1021.3 | 2 | 290 | 59 | 85 | 3.9 |
| 7/10/73 | 8 | 1022.0 | 2 | 280 | 62 | 68 | 4.8 |
| 7/10/73 | 9 | 1023.8 | 5 | 285 | 63 | 64 | 5.4 |
| 7/10/73 | 10 | 1023.9 | 4 | 275 | 64 | 61 | 5.5 |
| 7/10/73 | 11 | 1024.0 | 7 | 275 | 64 | 68 | 5.1 |
| 7/10/73 | 12 | 1024.5 | 6 | 345 | 60 | 90 | 4.4 |
| 7/10/73 | 13 | 1024.7 | 9 | 0 | 62 | 70 | 3.9 |
| 7/10/73 | 14 | 1025.0 | 5 | 350 | 66 | 56 | 3.6 |
| 7/10/73 | 15 | 1026.0 | 7 | 350 | 67 | 57 | 3.7 |
| 7/10/73 | 16 | 1026.0 | 11 | 345 | 62 | 69 | 4.2 |
| 7/10/73 | 17 | 1026.0 | 11 | 355 | 62 | 69 | 5.1 |
| 7/10/73 | 18 | 1026.0 | 11 | 5 | 60 | 65 | 6.1 |
| 7/10/73 | 19 | 1026.0 | 13 | 5 | 59 | 65 | 7.0 |
| 7/10/73 | 20 | 1026.0 | 10 | 5 | 58 | 67 | 7.7 |
| 7/10/73 | 21 | 1026.0 | 14 | 5 | 57 | 71 | 7.7 |
| 7/10/73 | 22 | 1026.0 | 10 | 10 | 56 | 71 | 6.9 |
| 7/10/73 | 23 | 1026.0 | 14 | 10 | 55 | 73 | 5.7 |
| 7/10/73 | 24 | 1026.0 | 10 | 15 | 54 | 75 | 4.1 |
| 7/11/73 | 1 | 1026.0 | 8 | 25 | 54 | 75 | 2.2 |
| 7/11/73 | 2 | 1026.0 | 10 | 30 | 54 | 72 | 0.7 |
| 7/11/73 | 3 | 1026.0 | 10 | 35 | 54 | 78 | -0.1 |
| 7/11/73 | 4 | 1026.0 | 4 | 100 | 50 | 88 | -0.2 |
| 7/11/73 | 5 | 1026.0 | 4 | 95 | 48 | 90 | 0.1 |
| 7/11/73 | 6 | 1026.0 | 7 | 85 | 50 | 89 | 1.2 |
| 7/11/73 | 7 | 1026.2 | 3 | 60 | 52 | 80 | 2.3 |
| 7/11/73 | 8 | 1026.2 | 10 | 350 | 58 | 64 | 3.7 |
| 7/11/73 | 9 | 1025.7 | 16 | 355 | 60 | 56 | 4.7 |
| 7/11/73 | 10 | 1025.2 | 16 | 355 | 61 | 55 | 5.4 |
| 7/11/73 | 11 | 1025.0 | 15 | 355 | 62 | 54 | 5.5 |
| 7/11/73 | 12 | 1024.7 | 14 | 350 | 64 | 56 | 5.1 |
| 7/11/73 | 13 | 1024.0 | 18 | 350 | 63 | 59 | 4.5 |
| 7/11/73 | 14 | 1023.6 | 20 | 355 | 62 | 58 | 3.9 |
| 7/11/73 | 15 | 1023.0 | 20 | 355 | 62 | 58 | 3.5 |
| 7/11/73 | 16 | 1022.5 | 23 | 355 | 62 | 59 | 3.6 |
| 7/11/73 | 17 | 1022.0 | 24 | 355 | 61 | 65 | 4.2 |
| 7/11/73 | 18 | 1021.9 | 26 | 350 | 60 | 65 | 5.1 |
| 7/11/73 | 19 | 1021.9 | 26 | 0 | 58 | 72 | 6.2 |
| 7/11/73 | 20 | 1021.9 | 25 | 0 | 57 | 76 | 7.1 |
| 7/11/73 | 21 | 1021.9 | 24 | 0 | 56 | 80 | 7.7 |
| 7/11/73 | 22 | 1021.9 | 23 | 0 | 55 | 81 | 7.5 |
| 7/11/73 | 23 | 1021.9 | 22 | 5 | 54 | 83 | 6.5 |
| 7/11/73 | 24 | 1021.9 | 14 | 10 | 52 | 85 | 5.2 |
| 7/12/73 | 1 | 1021.9 | 12 | 5 | 50 | 90 | 3.3 |
| 7/12/73 | 2 | 1021.9 | 10 | 0 | 50 | 90 | 1.5 |
| 7/12/73 | 3 | 1021.9 | 15 | 0 | 49 | 90 | 0.0 |
| 7/12/73 | 4 | 1021.9 | 17 | 5 | 50 | 90 | -0.7 |
| 7/12/73 | 5 | 1021.9 | 15 | 0 | 49 | 91 | -0.7 |
| 7/12/73 | 6 | 1021.9 | 12 | 0 | 50 | 90 | -0.0 |
| 7/12/73 | 7 | 1021.9 | 12 | 0 | 52 | 88 | 1.2 |
| 7/12/73 | 8 | 1021.9 | 15 | 0 | 58 | 74 | 2.6 |
| 7/12/73 | 9 | 1022.0 | 20 | 0 | 60 | 66 | 4.1 |
| 7/12/73 | 10 | 1022.0 | 20 | 355 | 62 | 65 | 5.1 |
| 7/12/73 | 11 | 1021.9 | 25 | 355 | 61 | 66 | 5.6 |
| 7/12/73 | 12 | 1021.9 | 26 | 355 | 62 | 65 | 5.7 |
| 7/12/73 | 13 | 1021.3 | 25 | 0 | 64 | 64 | 5.1 |
| 7/12/73 | 14 | 1021.0 | 24 | 355 | 62 | 66 | 4.5 |
| 7/12/73 | 15 | 1020.0 | 28 | 355 | 63 | 65 | 3.8 |
| 7/12/73 | 16 | 1019.6 | 28 | 350 | 62 | 66 | 3.5 |
| 7/12/73 | 17 | 1019.1 | 30 | 345 | 62 | 65 | 3.6 |
| 7/12/73 | 18 | 1018.9 | 27 | 350 | 60 | 68 | 4.4 |
| 7/12/73 | 19 | 1018.9 | 24 | 355 | 59 | 75 | 5.4 |
| 7/12/73 | 20 | 1018.9 | 25 | 355 | 58 | 84 | 6.5 |
| 7/12/73 | 21 | 1019.2 | 26 | 355 | 55 | 88 | 7.5 |
| 7/12/73 | 22 | 1019.5 | 20 | 5 | 54 | 89 | 7.7 |
| 7/12/73 | 23 | 1019.4 | 20 | 5 | 52 | 89 | 7.4 |
| 7/12/73 | 24 | 1019.3 | 14 | 0 | 52 | 90 | 6.3 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/13/73 | 1 | 1019.0 | 12 | 0 | 52 | 90 | 4.7 |
| 7/13/73 | 2 | 1019.0 | 10 | 355 | 52 | 90 | 2.7 |
| 7/13/73 | 3 | 1018.9 | 9 | 0 | 52 | 90 | 0.9 |
| 7/13/73 | 4 | 1018.8 | 7 | 0 | 52 | 90 | -0.4 |
| 7/13/73 | 5 | 1018.5 | 5 | 355 | 52 | 90 | -0.9 |
| 7/13/73 | 6 | 1018.5 | 5 | 345 | 52 | 90 | -0.7 |
| 7/13/73 | 7 | 1018.3 | 5 | 350 | 55 | 89 | 0.2 |
| 7/13/73 | 8 | 1018.3 | 7 | 340 | 55 | 80 | 1.7 |
| 7/13/73 | 9 | 1018.0 | 12 | 350 | 58 | 73 | 3.4 |
| 7/13/73 | 10 | 1017.9 | 14 | 345 | 60 | 67 | 4.8 |
| 7/13/73 | 11 | 1017.5 | 15 | 345 | 62 | 58 | 5.8 |
| 7/13/73 | 12 | 1017.0 | 17 | 345 | 64 | 60 | 6.1 |
| 7/13/73 | 13 | 1016.5 | 17 | 345 | 66 | 57 | 5.9 |
| 7/13/73 | 14 | 1016.0 | 16 | 350 | 68 | 54 | 5.3 |
| 7/13/73 | 15 | 1015.5 | 16 | 350 | 68 | 55 | 4.4 |
| 7/13/73 | 16 | 1015.1 | 18 | 355 | 67 | 56 | 3.8 |
| 7/13/73 | 17 | 1014.6 | 22 | 355 | 68 | 55 | 3.5 |
| 7/13/73 | 18 | 1014.2 | 22 | 350 | 68 | 54 | 3.9 |
| 7/13/73 | 19 | 1014.2 | 20 | 345 | 62 | 66 | 4.9 |
| 7/13/73 | 20 | 1014.7 | 17 | 0 | 60 | 68 | 6.0 |
| 7/13/73 | 21 | 1014.9 | 13 | 0 | 58 | 76 | 7.3 |
| 7/13/73 | 22 | 1015.1 | 17 | 345 | 54 | 83 | 8.1 |
| 7/13/73 | 23 | 1015.1 | 18 | 355 | 56 | 83 | 8.3 |
| 7/13/73 | 24 | 1015.1 | 14 | 350 | 54 | 83 | 7.5 |
| 7/14/73 | 1 | 1015.1 | 8 | 15 | 54 | 90 | 6.0 |
| 7/14/73 | 2 | 1015.1 | 7 | 0 | 50 | 90 | 4.4 |
| 7/14/73 | 3 | 1015.1 | 5 | 0 | 48 | 90 | 2.3 |
| 7/14/73 | 4 | 1015.1 | 4 | 350 | 49 | 90 | 0.5 |
| 7/14/73 | 5 | 1015.2 | 3 | 350 | 50 | 90 | -0.6 |
| 7/14/73 | 6 | 1015.3 | 1 | 340 | 51 | 90 | -0.8 |
| 7/14/73 | 7 | 1015.4 | 7 | 0 | 52 | 89 | -0.2 |
| 7/14/73 | 8 | 1015.5 | 10 | 355 | 56 | 80 | 1.1 |
| 7/14/73 | 9 | 1015.9 | 14 | 350 | 60 | 73 | 2.7 |
| 7/14/73 | 10 | 1016.0 | 14 | 345 | 65 | 67 | 4.5 |
| 7/14/73 | 11 | 1016.0 | 16 | 340 | 67 | 58 | 5.7 |
| 7/14/73 | 12 | 1015.9 | 14 | 345 | 66 | 60 | 6.5 |
| 7/14/73 | 13 | 1015.9 | 12 | 345 | 65 | 57 | 6.7 |
| 7/14/73 | 14 | 1015.8 | 6 | 350 | 64 | 54 | 6.1 |
| 7/14/73 | 15 | 1015.5 | 14 | 350 | 60 | 55 | 5.2 |
| 7/14/73 | 16 | 1015.2 | 15 | 350 | 58 | 56 | 4.3 |
| 7/14/73 | 17 | 1015.2 | 16 | 350 | 54 | 55 | 3.7 |
| 7/14/73 | 18 | 1015.1 | 20 | 350 | 54 | 54 | 3.7 |
| 7/14/73 | 19 | 1015.1 | 18 | 355 | 54 | 66 | 4.4 |
| 7/14/73 | 20 | 1015.2 | 16 | 355 | 54 | 68 | 5.4 |
| 7/14/73 | 21 | 1016.0 | 16 | 0 | 54 | 76 | 6.7 |
| 7/14/73 | 22 | 1016.2 | 13 | 0 | 53 | 83 | 7.9 |
| 7/14/73 | 23 | 1016.2 | 12 | 5 | 53 | 83 | 8.5 |
| 7/14/73 | 24 | 1016.3 | 13 | 0 | 53 | 83 | 8.3 |
| 7/15/73 | 1 | 1016.2 | 12 | 0 | 53 | 90 | 7.4 |
| 7/15/73 | 2 | 1016.2 | 13 | 0 | 52 | 90 | 5.7 |
| 7/15/73 | 3 | 1016.2 | 15 | 0 | 52 | 90 | 3.9 |
| 7/15/73 | 4 | 1016.3 | 13 | 0 | 52 | 90 | 1.7 |
| 7/15/73 | 5 | 1016.3 | 14 | 5 | 53 | 90 | 0.0 |
| 7/15/73 | 6 | 1016.5 | 10 | 0 | 54 | 90 | -0.7 |
| 7/15/73 | 7 | 1016.6 | 11 | 0 | 55 | 90 | -0.5 |
| 7/15/73 | 8 | 1016.6 | 11 | 355 | 56 | 86 | 0.5 |
| 7/15/73 | 9 | 1016.7 | 11 | 355 | 57 | 80 | 2.0 |
| 7/15/73 | 10 | 1016.6 | 11 | 340 | 59 | 80 | 3.9 |
| 7/15/73 | 11 | 1016.5 | 11 | 330 | 60 | 75 | 5.5 |
| 7/15/73 | 12 | 1016.2 | 13 | 355 | 62 | 72 | 6.5 |
| 7/15/73 | 13 | 1016.2 | 10 | 325 | 63 | 70 | 7.1 |
| 7/15/73 | 14 | 1016.0 | 10 | 325 | 64 | 69 | 6.7 |
| 7/15/73 | 15 | 1015.5 | 9 | 330 | 64 | 68 | 5.8 |
| 7/15/73 | 16 | 1015.1 | 7 | 335 | 64 | 70 | 4.9 |
| 7/15/73 | 17 | 1015.0 | 4 | 330 | 62 | 73 | 4.0 |
| 7/15/73 | 18 | 1014.5 | 7 | 345 | 60 | 74 | 3.6 |
| 7/15/73 | 19 | 1014.1 | 13 | 330 | 59 | 77 | 3.9 |
| 7/15/73 | 20 | 1014.0 | 10 | 340 | 57 | 80 | 4.8 |
| 7/15/73 | 21 | 1014.0 | 5 | 350 | 55 | 81 | 6.0 |
| 7/15/73 | 22 | 1014.1 | 7 | 335 | 53 | 82 | 7.4 |
| 7/15/73 | 23 | 1014.2 | 5 | 5 | 50 | 83 | 8.5 |
| 7/15/73 | 24 | 1014.2 | 7 | 350 | 50 | 84 | 8.7 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/16/73 | 1 | 1014.2 | 8 | 0 | 49 | 90 | 8.3 |
| 7/16/73 | 2 | 1014.2 | 0 | 50 | 48 | 90 | 6.9 |
| 7/16/73 | 3 | 1014.0 | 7 | 10 | 48 | 90 | 5.2 |
| 7/16/73 | 4 | 1014.0 | 1 | 10 | 48 | 90 | 3.1 |
| 7/16/73 | 5 | 1014.0 | 3 | 360 | 50 | 90 | 1.0 |
| 7/16/73 | 6 | 1014.0 | 0 | 350 | 52 | 90 | -0.2 |
| 7/16/73 | 7 | 1014.1 | 1 | 190 | 55 | 93 | -0.6 |
| 7/16/73 | 8 | 1014.1 | 4 | 225 | 54 | 86 | -0.0 |
| 7/16/73 | 9 | 1014.3 | 4 | 270 | 56 | 80 | 1.3 |
| 7/16/73 | 10 | 1014.5 | 5 | 240 | 58 | 80 | 3.1 |
| 7/16/73 | 11 | 1014.8 | 6 | 270 | 58 | 75 | 4.9 |
| 7/16/73 | 12 | 1014.9 | 6 | 265 | 58 | 72 | 6.2 |
| 7/16/73 | 13 | 1014.8 | 5 | 245 | 62 | 70 | 7.3 |
| 7/16/73 | 14 | 1014.6 | 4 | 245 | 62 | 69 | 7.4 |
| 7/16/73 | 15 | 1014.0 | 4 | 270 | 64 | 68 | 6.6 |
| 7/16/73 | 16 | 1013.9 | 5 | 270 | 64 | 70 | 5.5 |
| 7/16/73 | 17 | 1013.7 | 4 | 305 | 64 | 73 | 4.5 |
| 7/16/73 | 18 | 1013.2 | 4 | 315 | 63 | 74 | 3.5 |
| 7/16/73 | 19 | 1013.2 | 4 | 320 | 60 | 77 | 3.4 |
| 7/16/73 | 20 | 1013.3 | 0 | 305 | 59 | 80 | 4.0 |
| 7/16/73 | 21 | 1013.6 | 0 | 340 | 58 | 81 | 5.0 |
| 7/16/73 | 22 | 1013.9 | 0 | 250 | 57 | 82 | 6.3 |
| 7/16/73 | 23 | 1013.9 | 0 | 0 | 57 | 83 | 7.7 |
| 7/16/73 | 24 | 1013.8 | 1 | 225 | 57 | 84 | 8.5 |
| 7/17/73 | 1 | 1013.8 | 1 | 215 | 56 | 84 | 8.6 |
| 7/17/73 | 2 | 1013.6 | 1 | 180 | 56 | 85 | 7.8 |
| 7/17/73 | 3 | 1013.5 | 2 | 215 | 55 | 85 | 6.2 |
| 7/17/73 | 4 | 1013.5 | 0 | 160 | 55 | 89 | 4.3 |
| 7/17/73 | 5 | 1013.5 | 1 | 200 | 55 | 89 | 2.2 |
| 7/17/73 | 6 | 1014.0 | 1 | 220 | 55 | 89 | 0.5 |
| 7/17/73 | 7 | 1014.1 | 0 | 220 | 55 | 89 | -0.4 |
| 7/17/73 | 8 | 1014.3 | 3 | 205 | 56 | 88 | -0.3 |
| 7/17/73 | 9 | 1014.5 | 5 | 230 | 57 | 86 | 0.7 |
| 7/17/73 | 10 | 1014.7 | 4 | 195 | 58 | 84 | 2.3 |
| 7/17/73 | 11 | 1015.0 | 6 | 240 | 59 | 80 | 4.3 |
| 7/17/73 | 12 | 1015.0 | 4 | 270 | 60 | 79 | 5.8 |
| 7/17/73 | 13 | 1014.8 | 4 | 240 | 61 | 76 | 7.1 |
| 7/17/73 | 14 | 1014.5 | 4 | 230 | 61 | 74 | 7.7 |
| 7/17/73 | 15 | 1014.4 | 6 | 255 | 60 | 76 | 7.3 |
| 7/17/73 | 16 | 1014.3 | 2 | 240 | 60 | 78 | 6.2 |
| 7/17/73 | 17 | 1014.1 | 2 | 215 | 59 | 80 | 5.0 |
| 7/17/73 | 18 | 1014.0 | 2 | 220 | 58 | 84 | 3.9 |
| 7/17/73 | 19 | 1014.0 | 0 | 245 | 57 | 85 | 3.2 |
| 7/17/73 | 20 | 1014.1 | 0 | 250 | 56 | 86 | 3.1 |
| 7/17/73 | 21 | 1014.8 | 0 | 220 | 56 | 86 | 4.1 |
| 7/17/73 | 22 | 1014.9 | 1 | 210 | 56 | 87 | 5.3 |
| 7/17/73 | 23 | 1014.9 | 1 | 220 | 56 | 87 | 6.6 |
| 7/17/73 | 24 | 1015.2 | 2 | 220 | 56 | 87 | 7.8 |
| 7/18/73 | 1 | 1015.2 | 2 | 190 | 55 | 90 | 8.4 |
| 7/18/73 | 2 | 1015.1 | 1 | 190 | 55 | 91 | 8.1 |
| 7/18/73 | 3 | 1015.0 | 0 | 260 | 55 | 90 | 7.1 |
| 7/18/73 | 4 | 1015.0 | 0 | 230 | 54 | 92 | 5.4 |
| 7/18/73 | 5 | 1015.0 | 2 | 175 | 54 | 92 | 3.4 |
| 7/18/73 | 6 | 1015.1 | 1 | 185 | 54 | 91 | 1.4 |
| 7/18/73 | 7 | 1015.2 | 3 | 195 | 55 | 91 | 0.1 |
| 7/18/73 | 8 | 1015.5 | 3 | 210 | 56 | 90 | -0.2 |
| 7/18/73 | 9 | 1015.8 | 2 | 230 | 56 | 90 | 0.3 |
| 7/18/73 | 10 | 1016.0 | 3 | 245 | 56 | 89 | 1.7 |
| 7/18/73 | 11 | 1016.2 | 4 | 225 | 57 | 84 | 3.5 |
| 7/18/73 | 12 | 1016.2 | 6 | 210 | 60 | 72 | 5.3 |
| 7/18/73 | 13 | 1016.2 | 6 | 210 | 61 | 68 | 6.7 |
| 7/18/73 | 14 | 1016.2 | 5 | 210 | 61 | 68 | 7.7 |
| 7/18/73 | 15 | 1016.2 | 7 | 205 | 62 | 69 | 7.8 |
| 7/18/73 | 16 | 1016.1 | 7 | 205 | 60 | 74 | 6.9 |
| 7/18/73 | 17 | 1016.0 | 6 | 210 | 58 | 68 | 5.7 |
| 7/18/73 | 18 | 1016.0 | 5 | 225 | 56 | 86 | 4.3 |
| 7/18/73 | 19 | 1016.0 | 6 | 200 | 55 | 90 | 3.3 |
| 7/18/73 | 20 | 1016.0 | 6 | 195 | 54 | 92 | 2.8 |
| 7/18/73 | 21 | 1016.0 | 7 | 195 | 54 | 92 | 3.1 |
| 7/18/73 | 22 | 1016.0 | 6 | 195 | 54 | 92 | 4.1 |
| 7/18/73 | 23 | 1016.0 | 2 | 215 | 54 | 92 | 5.3 |
| 7/18/73 | 24 | 1016.0 | 3 | 185 | 54 | 92 | 6.6 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/19/73 | 1 | 1016.0 | 4 | 190 | 54 | 92 | 7.8 |
| 7/19/73 | 2 | 1015.9 | 1 | 180 | 54 | 92 | 7.9 |
| 7/19/73 | 3 | 1015.8 | 5 | 220 | 54 | 92 | 7.5 |
| 7/19/73 | 4 | 1015.9 | 5 | 210 | 54 | 92 | 6.1 |
| 7/19/73 | 5 | 1015.9 | 6 | 195 | 54 | 92 | 4.5 |
| 7/19/73 | 6 | 1015.9 | 5 | 210 | 54 | 92 | 2.6 |
| 7/19/73 | 7 | 1015.9 | 4 | 195 | 54 | 92 | 1.0 |
| 7/19/73 | 8 | 1015.9 | 4 | 210 | 55 | 91 | 0.1 |
| 7/19/73 | 9 | 1016.2 | 4 | 215 | 56 | 90 | 0.2 |
| 7/19/73 | 10 | 1016.3 | 4 | 240 | 58 | 83 | 1.2 |
| 7/19/73 | 11 | 1016.4 | 3 | 240 | 58 | 83 | 2.7 |
| 7/19/73 | 12 | 1017.8 | 6 | 215 | 59 | 79 | 4.6 |
| 7/19/73 | 13 | 1018.8 | 11 | 220 | 58 | 79 | 6.2 |
| 7/19/73 | 14 | 1018.2 | 3 | 220 | 60 | 67 | 7.5 |
| 7/19/73 | 15 | 1018.0 | 3 | 275 | 62 | 74 | 8.0 |
| 7/19/73 | 16 | 1018.0 | 3 | 260 | 60 | 76 | 7.5 |
| 7/19/73 | 17 | 1018.0 | 6 | 220 | 60 | 82 | 6.4 |
| 7/19/73 | 18 | 1018.1 | 4 | 195 | 58 | 84 | 5.1 |
| 7/19/73 | 19 | 1018.0 | 7 | 210 | 57 | 84 | 3.7 |
| 7/19/73 | 20 | 1017.8 | 2 | 180 | 57 | 86 | 2.7 |
| 7/19/73 | 21 | 1017.8 | 6 | 195 | 56 | 87 | 2.4 |
| 7/19/73 | 22 | 1017.6 | 4 | 190 | 56 | 87 | 2.8 |
| 7/19/73 | 23 | 1017.5 | 0 | 120 | 56 | 87 | 4.0 |
| 7/19/73 | 24 | 1017.5 | 0 | 120 | 56 | 88 | 5.2 |
| 7/20/73 | 1 | 1017.4 | 2 | 210 | 56 | 88 | 6.3 |
| 7/20/73 | 2 | 1017.2 | 3 | 200 | 56 | 89 | 7.2 |
| 7/20/73 | 3 | 1017.0 | 3 | 190 | 56 | 89 | 7.5 |
| 7/20/73 | 4 | 1017.0 | 2 | 200 | 56 | 89 | 6.7 |
| 7/20/73 | 5 | 1017.0 | 1 | 210 | 55 | 89 | 5.4 |
| 7/20/73 | 6 | 1017.2 | 4 | 195 | 56 | 89 | 3.8 |
| 7/20/73 | 7 | 1017.3 | 3 | 185 | 56 | 89 | 2.3 |
| 7/20/73 | 8 | 1018.0 | 6 | 205 | 57 | 88 | 0.9 |
| 7/20/73 | 9 | 1018.0 | 7 | 200 | 58 | 84 | 0.5 |
| 7/20/73 | 10 | 1018.2 | 7 | 210 | 60 | 88 | 1.1 |
| 7/20/73 | 11 | 1018.5 | 7 | 205 | 58 | 82 | 2.3 |
| 7/20/73 | 12 | 1018.6 | 7 | 205 | 60 | 80 | 4.0 |
| 7/20/73 | 13 | 1018.6 | 6 | 225 | 62 | 75 | 5.7 |
| 7/20/73 | 14 | 1018.7 | 6 | 235 | 60 | 78 | 7.1 |
| 7/20/73 | 15 | 1018.8 | 6 | 215 | 61 | 81 | 8.0 |
| 7/20/73 | 16 | 1018.8 | 4 | 240 | 63 | 77 | 8.1 |
| 7/20/73 | 17 | 1019.0 | 7 | 345 | 61 | 80 | 7.2 |
| 7/20/73 | 18 | 1019.0 | 6 | 350 | 61 | 77 | 5.9 |
| 7/20/73 | 19 | 1019.2 | 1 | 50 | 59 | 86 | 4.5 |
| 7/20/73 | 20 | 1019.5 | 4 | 15 | 58 | 89 | 3.1 |
| 7/20/73 | 21 | 1020.0 | 4 | 350 | 57 | 92 | 2.1 |
| 7/20/73 | 22 | 1020.0 | 4 | 5 | 56 | 92 | 2.0 |
| 7/20/73 | 23 | 1020.0 | 3 | 0 | 56 | 92 | 2.5 |
| 7/20/73 | 24 | 1020.0 | 3 | 355 | 56 | 92 | 3.6 |
| 7/21/73 | 1 | 1020.0 | 2 | 15 | 56 | 92 | 5.8 |
| 7/21/73 | 2 | 1020.0 | 1 | 235 | 55 | 92 | 5.9 |
| 7/21/73 | 3 | 1020.0 | 1 | 355 | 55 | 92 | 6.5 |
| 7/21/73 | 4 | 1020.0 | 1 | 225 | 54 | 92 | 6.6 |
| 7/21/73 | 5 | 1020.0 | 1 | 180 | 54 | 92 | 5.9 |
| 7/21/73 | 6 | 1020.1 | 1 | 240 | 56 | 92 | 4.7 |
| 7/21/73 | 7 | 1020.0 | 3 | 125 | 58 | 92 | 3.2 |
| 7/21/73 | 8 | 1020.0 | 5 | 240 | 60 | 86 | 2.1 |
| 7/21/73 | 9 | 1020.0 | 6 | 235 | 62 | 76 | 1.2 |
| 7/21/73 | 10 | 1020.0 | 7 | 235 | 62 | 71 | 1.2 |
| 7/21/73 | 11 | 1020.2 | 7 | 235 | 64 | 74 | 1.9 |
| 7/21/73 | 12 | 1020.0 | 6 | 215 | 62 | 80 | 3.3 |
| 7/21/73 | 13 | 1019.9 | 6 | 220 | 64 | 74 | 4.9 |
| 7/21/73 | 14 | 1019.6 | 5 | 295 | 62 | 76 | 6.4 |
| 7/21/73 | 15 | 1019.5 | 1 | 330 | 65 | 64 | 7.7 |
| 7/21/73 | 16 | 1019.2 | 5 | 240 | 64 | 69 | 8.2 |
| 7/21/73 | 17 | 1018.9 | 5 | 215 | 64 | 68 | 7.9 |
| 7/21/73 | 18 | 1018.7 | 6 | 215 | 62 | 76 | 6.9 |
| 7/21/73 | 19 | 1018.4 | 6 | 205 | 60 | 82 | 5.5 |
| 7/21/73 | 20 | 1018.4 | 6 | 205 | 59 | 84 | 4.0 |
| 7/21/73 | 21 | 1018.4 | 7 | 355 | 58 | 86 | 2.7 |
| 7/21/73 | 22 | 1018.4 | 10 | 0 | 58 | 88 | 1.8 |
| 7/21/73 | 23 | 1018.4 | 8 | 15 | 56 | 82 | 1.7 |
| 7/21/73 | 24 | 1018.4 | 6 | 10 | 56 | 82 | 2.2 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/22/73 | 1 | 1018.4 | 4 | 5 | 56 | 82 | 3.2 |
| 7/22/73 | 2 | 1018.4 | 2 | 20 | 56 | 82 | 4.4 |
| 7/22/73 | 3 | 1018.2 | 3 | 60 | 56 | 83 | 5.4 |
| 7/22/73 | 4 | 1018.2 | 1 | 130 | 54 | 90 | 5.9 |
| 7/22/73 | 5 | 1018.4 | 1 | 350 | 54 | 91 | 6.0 |
| 7/22/73 | 6 | 1018.6 | 4 | 260 | 54 | 90 | 5.4 |
| 7/22/73 | 7 | 1018.9 | 3 | 290 | 56 | 82 | 4.5 |
| 7/22/73 | 8 | 1018.9 | 4 | 10 | 58 | 76 | 3.2 |
| 7/22/73 | 9 | 1018.9 | 2 | 325 | 60 | 58 | 2.4 |
| 7/22/73 | 10 | 1018.9 | 3 | 310 | 62 | 58 | 1.9 |
| 7/22/73 | 11 | 1018.9 | 4 | 320 | 63 | 54 | 2.2 |
| 7/22/73 | 12 | 1018.9 | 5 | 300 | 64 | 50 | 3.1 |
| 7/22/73 | 13 | 1018.9 | 7 | 310 | 62 | 54 | 4.4 |
| 7/22/73 | 14 | 1018.9 | 7 | 355 | 62 | 57 | 5.8 |
| 7/22/73 | 15 | 1018.9 | 9 | 340 | 62 | 57 | 7.2 |
| 7/22/73 | 16 | 1018.3 | 8 | 345 | 63 | 56 | 8.1 |
| 7/22/73 | 17 | 1018.1 | 8 | 345 | 62 | 52 | 8.4 |
| 7/22/73 | 18 | 1018.0 | 6 | 340 | 60 | 57 | 7.9 |
| 7/22/73 | 19 | 1018.1 | 6 | 350 | 59 | 64 | 6.7 |
| 7/22/73 | 20 | 1018.1 | 3 | 0 | 56 | 74 | 5.3 |
| 7/22/73 | 21 | 1018.3 | 3 | 355 | 54 | 84 | 3.7 |
| 7/22/73 | 22 | 1018.3 | 1 | 55 | 52 | 90 | 2.2 |
| 7/22/73 | 23 | 1018.3 | 2 | 60 | 51 | 90 | 1.4 |
| 7/22/73 | 24 | 1018.3 | 2 | 55 | 51 | 90 | 1.2 |
| 7/23/73 | 1 | 1018.3 | 1 | 70 | 51 | 90 | 1.7 |
| 7/23/73 | 2 | 1018.3 | 2 | 75 | 51 | 90 | 2.7 |
| 7/23/73 | 3 | 1018.4 | 2 | 100 | 50 | 90 | 3.9 |
| 7/23/73 | 4 | 1018.6 | 4 | 70 | 50 | 90 | 4.9 |
| 7/23/73 | 5 | 1019.0 | 2 | 70 | 50 | 90 | 5.5 |
| 7/23/73 | 6 | 1019.2 | 3 | 85 | 51 | 90 | 5.6 |
| 7/23/73 | 7 | 1019.7 | 1 | 45 | 53 | 90 | 5.2 |
| 7/23/73 | 8 | 1020.2 | 2 | 55 | 58 | 77 | 4.5 |
| 7/23/73 | 9 | 1020.2 | 1 | 285 | 60 | 68 | 3.3 |
| 7/23/73 | 10 | 1020.5 | 3 | 310 | 62 | 64 | 2.9 |
| 7/23/73 | 11 | 1021.0 | 5 | 345 | 62 | 66 | 2.7 |
| 7/23/73 | 12 | 1021.2 | 7 | 355 | 63 | 60 | 3.0 |
| 7/23/73 | 13 | 1021.3 | 7 | 345 | 64 | 54 | 3.7 |
| 7/23/73 | 14 | 1021.6 | 10 | 350 | 64 | 57 | 5.0 |
| 7/23/73 | 15 | 1021.5 | 11 | 345 | 64 | 54 | 6.2 |
| 7/23/73 | 16 | 1021.4 | 11 | 345 | 63 | 59 | 7.4 |
| 7/23/73 | 17 | 1021.3 | 9 | 345 | 62 | 59 | 8.1 |
| 7/23/73 | 18 | 1021.3 | 9 | 345 | 60 | 62 | 8.3 |
| 7/23/73 | 19 | 1021.3 | 8 | 345 | 60 | 64 | 7.7 |
| 7/23/73 | 20 | 1021.5 | 9 | 350 | 57 | 73 | 6.4 |
| 7/23/73 | 21 | 1021.8 | 4 | 350 | 55 | 81 | 4.9 |
| 7/23/73 | 22 | 1022.0 | 0 | 60 | 52 | 88 | 3.2 |
| 7/23/73 | 23 | 1022.0 | 1 | 75 | 51 | 90 | 1.7 |
| 7/23/73 | 24 | 1022.1 | 2 | 60 | 50 | 90 | 0.8 |
| 7/24/73 | 1 | 1022.2 | 4 | 75 | 49 | 90 | 0.5 |
| 7/24/73 | 2 | 1022.3 | 5 | 100 | 49 | 90 | 0.9 |
| 7/24/73 | 3 | 1022.3 | 4 | 95 | 49 | 90 | 1.7 |
| 7/24/73 | 4 | 1022.4 | 6 | 90 | 49 | 90 | 2.9 |
| 7/24/73 | 5 | 1022.5 | 4 | 105 | 49 | 90 | 4.1 |
| 7/24/73 | 6 | 1022.7 | 5 | 90 | 50 | 90 | 4.9 |
| 7/24/73 | 7 | 1023.0 | 4 | 75 | 53 | 85 | 5.3 |
| 7/24/73 | 8 | 1023.2 | 3 | 0 | 60 | 72 | 5.2 |
| 7/24/73 | 9 | 1023.5 | 5 | 355 | 66 | 58 | 4.7 |
| 7/24/73 | 10 | 1023.5 | 8 | 350 | 66 | 53 | 3.9 |
| 7/24/73 | 11 | 1023.7 | 9 | 350 | 67 | 53 | 3.4 |
| 7/24/73 | 12 | 1023.8 | 9 | 345 | 66 | 50 | 3.1 |
| 7/24/73 | 13 | 1023.9 | 11 | 345 | 68 | 50 | 3.3 |
| 7/24/73 | 14 | 1024.0 | 10 | 345 | 70 | 49 | 5.1 |
| 7/24/73 | 15 | 1024.0 | 10 | 345 | 68 | 48 | 5.2 |
| 7/24/73 | 16 | 1024.1 | 12 | 345 | 67 | 52 | 6.3 |
| 7/24/73 | 17 | 1024.0 | 13 | 345 | 66 | 54 | 7.5 |
| 7/24/73 | 18 | 1024.1 | 11 | 350 | 66 | 54 | 8.2 |
| 7/24/73 | 19 | 1024.1 | 8 | 350 | 64 | 55 | 8.4 |
| 7/24/73 | 20 | 1024.2 | 6 | 355 | 60 | 66 | 7.7 |
| 7/24/73 | 21 | 1024.5 | 5 | 10 | 59 | 78 | 6.4 |
| 7/24/73 | 22 | 1024.8 | 5 | 350 | 56 | 84 | 4.8 |
| 7/24/73 | 23 | 1024.8 | 2 | 120 | 54 | 88 | 2.8 |
| 7/24/73 | 24 | 1024.8 | 0 | 95 | 53 | 89 | 1.2 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/25/73 | 1 | 1024.9 | 3 | 60 | 52 | 89 | -0.0 |
| 7/25/73 | 2 | 1024.9 | 3 | 65 | 52 | 90 | -0.3 |
| 7/25/73 | 3 | 1024.9 | 2 | 60 | 51 | 90 | -0.0 |
| 7/25/73 | 4 | 1024.9 | 4 | 70 | 51 | 90 | 0.9 |
| 7/25/73 | 5 | 1024.9 | 2 | 75 | 50 | 90 | 2.1 |
| 7/25/73 | 6 | 1025.0 | 3 | 75 | 52 | 90 | 3.5 |
| 7/25/73 | 7 | 1025.2 | 2 | 30 | 55 | 86 | 4.7 |
| 7/25/73 | 8 | 1025.3 | 2 | 0 | 60 | 77 | 5.3 |
| 7/25/73 | 9 | 1025.4 | 5 | 350 | 66 | 60 | 5.5 |
| 7/25/73 | 10 | 1025.2 | 10 | 345 | 66 | 59 | 5.1 |
| 7/25/73 | 11 | 1024.8 | 15 | 350 | 68 | 56 | 4.5 |
| 7/25/73 | 12 | 1024.5 | 11 | 350 | 69 | 56 | 3.8 |
| 7/25/73 | 13 | 1024.2 | 14 | 350 | 70 | 53 | 3.4 |
| 7/25/73 | 14 | 1023.9 | 12 | 0 | 71 | 53 | 3.6 |
| 7/25/73 | 15 | 1023.7 | 16 | 350 | 68 | 57 | 4.2 |
| 7/25/73 | 16 | 1023.2 | 18 | 350 | 69 | 58 | 5.2 |
| 7/25/73 | 17 | 1022.7 | 19 | 0 | 70 | 54 | 6.4 |
| 7/25/73 | 18 | 1021.9 | 20 | 350 | 68 | 54 | 7.6 |
| 7/25/73 | 19 | 1021.8 | 19 | 0 | 66 | 59 | 8.4 |
| 7/25/73 | 20 | 1021.9 | 18 | 0 | 62 | 68 | 8.7 |
| 7/25/73 | 21 | 1022.1 | 16 | 5 | 61 | 75 | 8.0 |
| 7/25/73 | 22 | 1022.2 | 17 | 355 | 60 | 80 | 6.6 |
| 7/25/73 | 23 | 1022.2 | 17 | 355 | 59 | 86 | 4.9 |
| 7/25/73 | 24 | 1022.2 | 11 | 0 | 57 | 88 | 2.7 |
| 7/26/73 | 1 | 1022.0 | 9 | 10 | 56 | 89 | 0.7 |
| 7/26/73 | 2 | 1021.7 | 4 | 350 | 54 | 90 | -0.6 |
| 7/26/73 | 3 | 1021.5 | 9 | 10 | 54 | 90 | -1.0 |
| 7/26/73 | 4 | 1021.5 | 8 | 0 | 52 | 90 | -0.7 |
| 7/26/73 | 5 | 1021.6 | 1 | 20 | 50 | 90 | 0.2 |
| 7/26/73 | 6 | 1021.6 | 7 | 355 | 52 | 91 | 1.7 |
| 7/26/73 | 7 | 1021.5 | 9 | 355 | 57 | 90 | 3.3 |
| 7/26/73 | 8 | 1021.4 | 11 | 0 | 60 | 78 | 4.7 |
| 7/26/73 | 9 | 1021.2 | 15 | 355 | 62 | 74 | 5.8 |
| 7/26/73 | 10 | 1020.7 | 15 | 350 | 64 | 68 | 5.9 |
| 7/26/73 | 11 | 1020.3 | 18 | 350 | 64 | 68 | 5.7 |
| 7/26/73 | 12 | 1019.8 | 20 | 350 | 66 | 65 | 4.9 |
| 7/26/73 | 13 | 1019.5 | 22 | 350 | 67 | 66 | 4.1 |
| 7/26/73 | 14 | 1019.1 | 23 | 350 | 66 | 66 | 3.5 |
| 7/26/73 | 15 | 1018.6 | 20 | 0 | 66 | 66 | 3.5 |
| 7/26/73 | 16 | 1018.0 | 24 | 355 | 66 | 66 | 4.1 |
| 7/26/73 | 17 | 1017.1 | 28 | 355 | 65 | 68 | 5.2 |
| 7/26/73 | 18 | 1016.3 | 24 | 355 | 62 | 75 | 6.5 |
| 7/26/73 | 19 | 1016.2 | 22 | 355 | 60 | 84 | 7.8 |
| 7/26/73 | 20 | 1016.2 | 17 | 0 | 56 | 87 | 8.8 |
| 7/26/73 | 21 | 1016.5 | 22 | 5 | 56 | 87 | 9.1 |
| 7/26/73 | 22 | 1016.6 | 16 | 350 | 56 | 88 | 8.4 |
| 7/26/73 | 23 | 1016.6 | 15 | 10 | 55 | 89 | 6.8 |
| 7/26/73 | 24 | 1016.5 | 8 | 20 | 54 | 90 | 4.9 |
| 7/27/73 | 1 | 1016.2 | 2 | 20 | 53 | 90 | 2.5 |
| 7/27/73 | 2 | 1016.0 | 7 | 350 | 52 | 90 | 0.2 |
| 7/27/73 | 3 | 1015.8 | 5 | 0 | 49 | 90 | -1.1 |
| 7/27/73 | 4 | 1015.8 | 2 | 5 | 50 | 90 | -1.6 |
| 7/27/73 | 5 | 1015.7 | 2 | 105 | 52 | 90 | -1.2 |
| 7/27/73 | 6 | 1015.9 | 4 | 10 | 52 | 90 | 0.0 |
| 7/27/73 | 7 | 1015.9 | 3 | 45 | 54 | 90 | 1.7 |
| 7/27/73 | 8 | 1015.8 | 4 | 350 | 58 | 89 | 3.6 |
| 7/27/73 | 9 | 1015.4 | 5 | 345 | 64 | 70 | 5.2 |
| 7/27/73 | 10 | 1015.0 | 7 | 355 | 68 | 64 | 6.3 |
| 7/27/73 | 11 | 1015.1 | 12 | 340 | 66 | 64 | 6.7 |
| 7/27/73 | 12 | 1015.0 | 10 | 340 | 69 | 63 | 6.1 |
| 7/27/73 | 13 | 1015.0 | 13 | 350 | 72 | 56 | 5.2 |
| 7/27/73 | 14 | 1015.0 | 12 | 340 | 70 | 58 | 4.2 |
| 7/27/73 | 15 | 1015.0 | 12 | 325 | 68 | 62 | 3.5 |
| 7/27/73 | 16 | 1014.9 | 8 | 0 | 68 | 64 | 3.2 |
| 7/27/73 | 17 | 1014.9 | 15 | 345 | 69 | 64 | 3.9 |
| 7/27/73 | 18 | 1014.9 | 15 | 345 | 64 | 76 | 5.0 |
| 7/27/73 | 19 | 1015.0 | 17 | 345 | 62 | 79 | 6.6 |
| 7/27/73 | 20 | 1015.0 | 16 | 345 | 60 | 84 | 8.1 |
| 7/27/73 | 21 | 1015.2 | 13 | 355 | 58 | 86 | 9.4 |
| 7/27/73 | 22 | 1015.5 | 7 | 340 | 54 | 89 | 9.7 |
| 7/27/73 | 23 | 1015.9 | 8 | 355 | 54 | 89 | 8.8 |
| 7/27/73 | 24 | 1015.9 | 4 | 85 | 53 | 89 | 7.1 |
| 7/28/73 | 1 | 1015.8 | 3 | 80 | 53 | 89 | 4.9 |
| 7/28/73 | 2 | 1015.6 | 2 | 50 | 52 | 89 | 2.3 |
| 7/28/73 | 3 | 1015.5 | 1 | 90 | 51 | 89 | -0.0 |
| 7/28/73 | 4 | 1015.6 | 2 | 0 | 52 | 89 | -1.6 |
| 7/28/73 | 5 | 1015.6 | 1 | 60 | 52 | 89 | -2.0 |
| 7/28/73 | 6 | 1015.6 | 0 | 90 | 52 | 89 | -1.4 |
| 7/28/73 | 7 | 1015.7 | 0 | 330 | 56 | 89 | 0.2 |
| 7/28/73 | 8 | 1015.8 | 7 | 345 | 60 | 83 | 2.0 |
| 7/28/73 | 9 | 1015.9 | 12 | 350 | 62 | 74 | 4.2 |
| 7/28/73 | 10 | 1015.8 | 10 | 355 | 66 | 65 | 5.9 |
| 7/28/73 | 11 | 1015.6 | 15 | 345 | 64 | 66 | 7.0 |
| 7/28/73 | 12 | 1015.2 | 19 | 345 | 64 | 71 | 7.3 |
| 7/28/73 | 13 | 1014.9 | 22 | 350 | 64 | 74 | 6.5 |
| 7/28/73 | 14 | 1014.9 | 20 | 0 | 66 | 72 | 5.3 |
| 7/28/73 | 15 | 1014.1 | 19 | 345 | 66 | 70 | 4.1 |
| 7/28/73 | 16 | 1013.8 | 20 | 350 | 63 | 74 | 3.1 |
| 7/28/73 | 17 | 1013.5 | 14 | 355 | 63 | 75 | 2.9 |
| 7/28/73 | 18 | 1013.2 | 14 | 340 | 60 | 78 | 3.7 |
| 7/28/73 | 19 | 1013.1 | 15 | 350 | 60 | 73 | 5.0 |
| 7/28/73 | 20 | 1013.1 | 18 | 350 | 58 | 82 | 6.8 |
| 7/28/73 | 21 | 1013.4 | 19 | 350 | 56 | 88 | 8.5 |
| 7/28/73 | 22 | 1013.9 | 11 | 350 | 54 | 88 | 9.8 |
| 7/28/73 | 23 | 1014.0 | 14 | 350 | 53 | 90 | 10.0 |
| 7/28/73 | 24 | 1014.4 | 15 | 0 | 52 | 90 | 9.1 |
| 7/29/73 | 1 | 1014.2 | 17 | 355 | 50 | 90 | 7.2 |
| 7/29/73 | 2 | 1014.3 | 13 | 350 | 49 | 90 | 4.9 |
| 7/29/73 | 3 | 1014.6 | 9 | 15 | 50 | 90 | 2.1 |
| 7/29/73 | 4 | 1014.9 | 13 | 10 | 50 | 90 | -0.4 |
| 7/29/73 | 5 | 1015.1 | 5 | 30 | 51 | 90 | -1.9 |
| 7/29/73 | 6 | 1015.5 | 13 | 0 | 51 | 89 | -2.2 |
| 7/29/73 | 7 | 1016.1 | 10 | 0 | 51 | 89 | -1.2 |
| 7/29/73 | 8 | 1016.6 | 12 | 350 | 53 | 89 | 0.6 |
| 7/29/73 | 9 | 1017.1 | 10 | 355 | 55 | 84 | 2.8 |
| 7/29/73 | 10 | 1017.1 | 16 | 345 | 58 | 80 | 4.9 |
| 7/29/73 | 11 | 1017.0 | 16 | 340 | 60 | 72 | 6.8 |
| 7/29/73 | 12 | 1017.2 | 17 | 345 | 62 | 68 | 7.8 |
| 7/29/73 | 13 | 1017.8 | 8 | 330 | 63 | 64 | 7.7 |
| 7/29/73 | 14 | 1018.0 | 5 | 355 | 63 | 64 | 6.5 |
| 7/29/73 | 15 | 1018.0 | 7 | 340 | 61 | 69 | 5.1 |
| 7/29/73 | 16 | 1017.7 | 8 | 340 | 59 | 78 | 3.6 |
| 7/29/73 | 17 | 1017.4 | 8 | 345 | 57 | 84 | 2.5 |
| 7/29/73 | 18 | 1017.2 | 10 | 345 | 55 | 86 | 2.3 |
| 7/29/73 | 19 | 1017.1 | 11 | 350 | 53 | 88 | 3.2 |
| 7/29/73 | 20 | 1017.1 | 12 | 355 | 50 | 90 | 4.8 |
| 7/29/73 | 21 | 1017.2 | 13 | 355 | 50 | 90 | 6.6 |
| 7/29/73 | 22 | 1017.3 | 12 | 355 | 50 | 90 | 8.4 |
| 7/29/73 | 23 | 1017.6 | 12 | 0 | 50 | 90 | 9.7 |
| 7/29/73 | 24 | 1017.7 | 8 | 355 | 49 | 90 | 10.0 |
| 7/30/73 | 1 | 1017.8 | 6 | 0 | 50 | 90 | 8.8 |
| 7/30/73 | 2 | 1017.8 | 8 | 350 | 49 | 90 | 6.8 |
| 7/30/73 | 3 | 1017.9 | 10 | 0 | 50 | 90 | 4.5 |
| 7/30/73 | 4 | 1018.0 | 7 | 350 | 50 | 90 | 1.5 |
| 7/30/73 | 5 | 1018.1 | 6 | 355 | 51 | 89 | -0.8 |
| 7/30/73 | 6 | 1018.5 | 5 | 350 | 51 | 89 | -2.2 |
| 7/30/73 | 7 | 1018.9 | 4 | 345 | 52 | 88 | -2.2 |
| 7/30/73 | 8 | 1019.1 | 6 | 350 | 53 | 88 | -0.7 |
| 7/30/73 | 9 | 1019.1 | 6 | 355 | 55 | 86 | 1.3 |
| 7/30/73 | 10 | 1019.2 | 12 | 345 | 58 | 84 | 3.6 |
| 7/30/73 | 11 | 1019.3 | 13 | 345 | 60 | 77 | 5.8 |
| 7/30/73 | 12 | 1019.5 | 17 | 340 | 62 | 72 | 7.5 |
| 7/30/73 | 13 | 1019.5 | 16 | 345 | 63 | 66 | 8.3 |
| 7/30/73 | 14 | 1019.5 | 15 | 345 | 62 | 72 | 7.7 |
| 7/30/73 | 15 | 1019.1 | 13 | 350 | 61 | 76 | 6.3 |
| 7/30/73 | 16 | 1018.9 | 16 | 355 | 59 | 82 | 4.6 |
| 7/30/73 | 17 | 1018.7 | 16 | 0 | 57 | 84 | 2.9 |
| 7/30/73 | 18 | 1018.6 | 18 | 350 | 55 | 86 | 1.9 |
| 7/30/73 | 19 | 1018.5 | 16 | 355 | 53 | 88 | 1.7 |
| 7/30/73 | 20 | 1018.8 | 15 | 0 | 50 | 90 | 2.7 |
| 7/30/73 | 21 | 1019.0 | 14 | 350 | 50 | 90 | 4.5 |
| 7/30/73 | 22 | 1019.1 | 15 | 355 | 50 | 90 | 6.3 |
| 7/30/73 | 23 | 1019.3 | 13 | 355 | 50 | 90 | 8.1 |
| 7/30/73 | 24 | 1019.5 | 11 | 350 | 49 | 90 | 9.4 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 7/31/73 | 1 | 1019.6 | 10 | 355 | 48 | 90 | 9.5 |
| 7/31/73 | 2 | 1019.8 | 10 | 5 | 48 | 90 | 8.2 |
| 7/31/73 | 3 | 1020.0 | 6 | 5 | 49 | 90 | 6.2 |
| 7/31/73 | 4 | 1020.0 | 6 | 30 | 50 | 90 | 3.6 |
| 7/31/73 | 5 | 1020.1 | 7 | 15 | 50 | 90 | 0.9 |
| 7/31/73 | 6 | 1020.6 | 10 | 355 | 50 | 90 | -1.1 |
| 7/31/73 | 7 | 1021.0 | 12 | 0 | 52 | 89 | -1.9 |
| 7/31/73 | 8 | 1021.0 | 10 | 350 | 54 | 88 | -1.6 |
| 7/31/73 | 9 | 1021.0 | 16 | 355 | 56 | 86 | 0.1 |
| 7/31/73 | 10 | 1020.9 | 15 | 355 | 58 | 78 | 2.3 |
| 7/31/73 | 11 | 1020.9 | 15 | 350 | 59 | 72 | 4.7 |
| 7/31/73 | 12 | 1020.8 | 17 | 345 | 60 | 70 | 6.7 |
| 7/31/73 | 13 | 1020.4 | 17 | 345 | 60 | 70 | 8.2 |
| 7/31/73 | 14 | 1020.2 | 15 | 350 | 60 | 70 | 8.6 |
| 7/31/73 | 15 | 1020.3 | 17 | 350 | 59 | 74 | 7.5 |
| 7/31/73 | 16 | 1020.0 | 17 | 350 | 58 | 78 | 5.8 |
| 7/31/73 | 17 | 1019.8 | 20 | 355 | 55 | 82 | 4.1 |
| 7/31/73 | 18 | 1019.6 | 17 | 350 | 52 | 86 | 2.2 |
| 7/31/73 | 19 | 1019.4 | 18 | 0 | 50 | 90 | 1.3 |
| 7/31/73 | 20 | 1019.6 | 17 | 355 | 50 | 90 | 1.3 |
| 7/31/73 | 21 | 1019.8 | 16 | 355 | 50 | 90 | 2.5 |
| 7/31/73 | 22 | 1019.9 | 15 | 350 | 50 | 90 | 4.2 |
| 7/31/73 | 23 | 1019.9 | 9 | 345 | 49 | 90 | 6.0 |
| 7/31/73 | 24 | 1020.0 | 10 | 350 | 49 | 90 | 7.7 |
| 8/ 1/73 | 1 | 1020.2 | 10 | 350 | 48 | 90 | 8.7 |
| 8/ 1/73 | 2 | 1020.3 | 12 | 355 | 48 | 90 | 8.7 |
| 8/ 1/73 | 3 | 1020.4 | 9 | 5 | 49 | 90 | 7.4 |
| 8/ 1/73 | 4 | 1020.5 | 9 | 5 | 50 | 90 | 5.4 |
| 8/ 1/73 | 5 | 1020.7 | 7 | 5 | 50 | 90 | 2.9 |
| 8/ 1/73 | 6 | 1020.8 | 8 | 350 | 50 | 90 | 0.6 |
| 8/ 1/73 | 7 | 1020.8 | 12 | 355 | 50 | 90 | -1.1 |
| 8/ 1/73 | 8 | 1021.0 | 12 | 355 | 54 | 88 | -1.4 |
| 8/ 1/73 | 9 | 1021.1 | 11 | 355 | 56 | 84 | -0.4 |
| 8/ 1/73 | 10 | 1021.2 | 17 | 355 | 58 | 78 | 1.3 |
| 8/ 1/73 | 11 | 1021.2 | 18 | 345 | 60 | 74 | 3.5 |
| 8/ 1/73 | 12 | 1021.1 | 20 | 350 | 61 | 71 | 5.6 |
| 8/ 1/73 | 13 | 1021.0 | 19 | 345 | 61 | 71 | 7.5 |
| 8/ 1/73 | 14 | 1020.9 | 20 | 350 | 62 | 69 | 8.6 |
| 8/ 1/73 | 15 | 1020.5 | 22 | 355 | 61 | 70 | 8.4 |
| 8/ 1/73 | 16 | 1020.0 | 24 | 355 | 60 | 73 | 7.0 |
| 8/ 1/73 | 17 | 1019.6 | 24 | 0 | 59 | 76 | 5.3 |
| 8/ 1/73 | 18 | 1019.2 | 24 | 355 | 58 | 82 | 3.2 |
| 8/ 1/73 | 19 | 1019.2 | 20 | 0 | 55 | 87 | 1.6 |
| 8/ 1/73 | 20 | 1019.4 | 23 | 5 | 54 | 88 | 0.8 |
| 8/ 1/73 | 21 | 1020.0 | 17 | 0 | 53 | 89 | 1.0 |
| 8/ 1/73 | 22 | 1020.0 | 13 | 0 | 52 | 89 | 2.2 |
| 8/ 1/73 | 23 | 1020.1 | 10 | 350 | 51 | 90 | 3.9 |
| 8/ 1/73 | 24 | 1020.2 | 7 | 345 | 50 | 90 | 5.6 |
| 8/ 2/73 | 1 | 1020.4 | 1 | 60 | 48 | 90 | 7.1 |
| 8/ 2/73 | 2 | 1020.3 | 4 | 340 | 50 | 90 | 7.9 |
| 8/ 2/73 | 3 | 1020.1 | 2 | 30 | 50 | 90 | 7.8 |
| 8/ 2/73 | 4 | 1020.0 | 0 | 80 | 50 | 90 | 6.3 |
| 8/ 2/73 | 5 | 1020.0 | 0 | 100 | 49 | 90 | 4.6 |
| 8/ 2/73 | 6 | 1020.1 | 1 | 90 | 50 | 90 | 2.3 |
| 8/ 2/73 | 7 | 1020.1 | 2 | 45 | 52 | 89 | 0.4 |
| 8/ 2/73 | 8 | 1020.3 | 10 | 355 | 56 | 82 | -0.5 |
| 8/ 2/73 | 9 | 1020.1 | 12 | 345 | 62 | 70 | -0.4 |
| 8/ 2/73 | 10 | 1020.0 | 14 | 345 | 60 | 69 | 0.7 |
| 8/ 2/73 | 11 | 1019.8 | 18 | 350 | 62 | 68 | 2.6 |
| 8/ 2/73 | 12 | 1019.8 | 11 | 350 | 62 | 68 | 4.6 |
| 8/ 2/73 | 13 | 1019.7 | 16 | 340 | 63 | 66 | 6.5 |
| 8/ 2/73 | 14 | 1019.5 | 17 | 345 | 63 | 66 | 8.0 |
| 8/ 2/73 | 15 | 1018.9 | 17 | 345 | 62 | 66 | 8.6 |
| 8/ 2/73 | 16 | 1018.5 | 16 | 350 | 62 | 68 | 8.0 |
| 8/ 2/73 | 17 | 1017.9 | 19 | 345 | 61 | 71 | 6.6 |
| 8/ 2/73 | 18 | 1017.6 | 22 | 355 | 60 | 75 | 4.8 |
| 8/ 2/73 | 19 | 1017.5 | 19 | 355 | 57 | 84 | 3.9 |
| 8/ 2/73 | 20 | 1017.5 | 19 | 5 | 56 | 86 | 1.3 |
| 8/ 2/73 | 21 | 1017.7 | 24 | 0 | 56 | 86 | 0.8 |
| 8/ 2/73 | 22 | 1018.0 | 21 | 350 | 55 | 88 | 1.0 |
| 8/ 2/73 | 23 | 1018.1 | 16 | 0 | 55 | 88 | 2.3 |
| 8/ 2/73 | 24 | 1018.7 | 15 | 5 | 55 | 88 | 3.8 |
| 8/ 3/73 | 1 | 1018.6 | 14 | 5 | 55 | 88 | 5.3 |
| 8/ 3/73 | 2 | 1018.6 | 12 | 355 | 55 | 88 | 6.5 |
| 8/ 3/73 | 3 | 1018.6 | 14 | 5 | 54 | 88 | 7.2 |
| 8/ 3/73 | 4 | 1018.6 | 13 | 0 | 54 | 88 | 6.8 |
| 8/ 3/73 | 5 | 1018.7 | 18 | 10 | 55 | 88 | 5.6 |
| 8/ 3/73 | 6 | 1018.8 | 13 | 355 | 56 | 87 | 4.0 |
| 8/ 3/73 | 7 | 1018.9 | 12 | 0 | 58 | 84 | 2.2 |
| 8/ 3/73 | 8 | 1019.0 | 13 | 350 | 59 | 78 | 0.9 |
| 8/ 3/73 | 9 | 1019.4 | 14 | 350 | 60 | 77 | 0.4 |
| 8/ 3/73 | 10 | 1019.8 | 12 | 345 | 61 | 72 | 0.9 |
| 8/ 3/73 | 11 | 1019.9 | 14 | 350 | 60 | 70 | 1.9 |
| 8/ 3/73 | 12 | 1020.0 | 12 | 350 | 62 | 69 | 3.8 |
| 8/ 3/73 | 13 | 1020.0 | 10 | 345 | 62 | 67 | 5.5 |
| 8/ 3/73 | 14 | 1019.9 | 11 | 355 | 62 | 67 | 7.1 |
| 8/ 3/73 | 15 | 1019.5 | 13 | 345 | 61 | 67 | 8.2 |
| 8/ 3/73 | 16 | 1019.3 | 12 | 350 | 60 | 68 | 8.3 |
| 8/ 3/73 | 17 | 1019.0 | 14 | 350 | 59 | 72 | 7.4 |
| 8/ 3/73 | 18 | 1018.9 | 13 | 345 | 57 | 74 | 5.7 |
| 8/ 3/73 | 19 | 1018.9 | 17 | 0 | 56 | 82 | 4.2 |
| 8/ 3/73 | 20 | 1018.9 | 12 | 355 | 55 | 84 | 2.3 |
| 8/ 3/73 | 21 | 1018.9 | 14 | 350 | 55 | 86 | 1.0 |
| 8/ 3/73 | 22 | 1018.9 | 15 | 350 | 55 | 89 | 0.6 |
| 8/ 3/73 | 23 | 1019.0 | 13 | 345 | 55 | 89 | 1.1 |
| 8/ 3/73 | 24 | 1019.0 | 10 | 350 | 55 | 89 | 2.1 |
| 8/ 4/73 | 1 | 1019.0 | 6 | 345 | 54 | 89 | 3.6 |
| 8/ 4/73 | 2 | 1019.0 | 5 | 355 | 54 | 89 | 4.9 |
| 8/ 4/73 | 3 | 1018.9 | 7 | 350 | 55 | 89 | 5.9 |
| 8/ 4/73 | 4 | 1018.9 | 3 | 15 | 55 | 89 | 6.3 |
| 8/ 4/73 | 5 | 1018.8 | 5 | 345 | 54 | 89 | 6.1 |
| 8/ 4/73 | 6 | 1018.9 | 6 | 0 | 54 | 89 | 5.0 |
| 8/ 4/73 | 7 | 1018.9 | 6 | 350 | 56 | 89 | 3.8 |
| 8/ 4/73 | 8 | 1019.0 | 5 | 0 | 59 | 87 | 2.4 |
| 8/ 4/73 | 9 | 1019.0 | 4 | 345 | 62 | 80 | 1.7 |
| 8/ 4/73 | 10 | 1018.9 | 5 | 355 | 63 | 73 | 1.4 |
| 8/ 4/73 | 11 | 1018.8 | 6 | 0 | 66 | 65 | 2.0 |
| 8/ 4/73 | 12 | 1018.7 | 14 | 340 | 65 | 66 | 3.3 |
| 8/ 4/73 | 13 | 1018.5 | 11 | 350 | 65 | 68 | 4.9 |
| 8/ 4/73 | 14 | 1018.5 | 14 | 345 | 64 | 72 | 6.3 |
| 8/ 4/73 | 15 | 1018.2 | 15 | 350 | 63 | 69 | 7.7 |
| 8/ 4/73 | 16 | 1017.9 | 13 | 345 | 62 | 74 | 8.2 |
| 8/ 4/73 | 17 | 1017.7 | 7 | 350 | 61 | 76 | 8.1 |
| 8/ 4/73 | 18 | 1017.3 | 15 | 350 | 58 | 84 | 7.1 |
| 8/ 4/73 | 19 | 1017.3 | 17 | 355 | 57 | 86 | 5.7 |
| 8/ 4/73 | 20 | 1017.2 | 15 | 350 | 57 | 87 | 4.0 |
| 8/ 4/73 | 21 | 1017.5 | 17 | 355 | 56 | 87 | 2.3 |
| 8/ 4/73 | 22 | 1017.7 | 13 | 355 | 56 | 87 | 1.3 |
| 8/ 4/73 | 23 | 1018.0 | 15 | 15 | 56 | 87 | 0.9 |
| 8/ 4/73 | 24 | 1018.0 | 12 | 15 | 54 | 87 | 1.2 |
| 8/ 5/73 | 1 | 1018.0 | 12 | 355 | 53 | 88 | 2.1 |
| 8/ 5/73 | 2 | 1018.0 | 5 | 15 | 52 | 90 | 3.3 |
| 8/ 5/73 | 3 | 1017.9 | 3 | 40 | 50 | 90 | 4.6 |
| 8/ 5/73 | 4 | 1017.9 | 1 | 80 | 50 | 90 | 5.4 |
| 8/ 5/73 | 5 | 1017.9 | 3 | 25 | 50 | 90 | 5.7 |
| 8/ 5/73 | 6 | 1018.0 | 2 | 35 | 52 | 90 | 5.5 |
| 8/ 5/73 | 7 | 1018.0 | 2 | 35 | 56 | 88 | 4.8 |
| 8/ 5/73 | 8 | 1018.0 | 5 | 355 | 60 | 72 | 3.8 |
| 8/ 5/73 | 9 | 1018.0 | 6 | 340 | 62 | 65 | 2.9 |
| 8/ 5/73 | 10 | 1017.9 | 9 | 350 | 64 | 63 | 2.5 |
| 8/ 5/73 | 11 | 1017.6 | 5 | 355 | 66 | 58 | 2.5 |
| 8/ 5/73 | 12 | 1017.1 | 13 | 345 | 66 | 59 | 3.3 |
| 8/ 5/73 | 13 | 1017.1 | 12 | 350 | 66 | 59 | 4.4 |
| 8/ 5/73 | 14 | 1017.0 | 11 | 345 | 66 | 62 | 5.6 |
| 8/ 5/73 | 15 | 1016.7 | 12 | 345 | 66 | 64 | 6.8 |
| 8/ 5/73 | 16 | 1016.5 | 4 | 335 | 65 | 66 | 7.7 |
| 8/ 5/73 | 17 | 1016.3 | 3 | 20 | 64 | 72 | 8.1 |
| 8/ 5/73 | 18 | 1015.8 | 1 | 350 | 60 | 84 | 7.8 |
| 8/ 5/73 | 19 | 1015.5 | 3 | 350 | 60 | 86 | 6.7 |
| 8/ 5/73 | 20 | 1015.5 | 2 | 335 | 56 | 88 | 5.5 |
| 8/ 5/73 | 21 | 1015.5 | 5 | 5 | 57 | 89 | 4.0 |
| 8/ 5/73 | 22 | 1015.5 | 7 | 5 | 57 | 89 | 2.5 |
| 8/ 5/73 | 23 | 1015.3 | 7 | 355 | 56 | 89 | 1.6 |
| 8/ 5/73 | 24 | 1015.2 | 9 | 5 | 56 | 89 | 1.1 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 8/ 6/73 | 1 | 1015.1 | 9 | 0 | 57 | 88 | 1.3 |
| 8/ 6/73 | 2 | 1015.0 | 8 | 5 | 57 | 88 | 2.1 |
| 8/ 6/73 | 3 | 1015.0 | 11 | 0 | 57 | 88 | 3.3 |
| 8/ 6/73 | 4 | 1015.0 | 10 | 350 | 57 | 87 | 4.3 |
| 8/ 6/73 | 5 | 1015.1 | 7 | 5 | 57 | 86 | 5.1 |
| 8/ 6/73 | 6 | 1015.2 | 6 | 5 | 57 | 87 | 5.5 |
| 8/ 6/73 | 7 | 1015.2 | 7 | 345 | 58 | 85 | 5.5 |
| 8/ 6/73 | 8 | 1015.4 | 8 | 355 | 59 | 81 | 5.0 |
| 8/ 6/73 | 9 | 1015.5 | 13 | 355 | 60 | 76 | 4.5 |
| 8/ 6/73 | 10 | 1015.7 | 12 | 345 | 60 | 74 | 3.9 |
| 8/ 6/73 | 11 | 1015.8 | 13 | 345 | 60 | 73 | 3.5 |
| 8/ 6/73 | 12 | 1015.7 | 14 | 340 | 61 | 71 | 3.7 |
| 8/ 6/73 | 13 | 1015.5 | 15 | 345 | 61 | 71 | 4.2 |
| 8/ 6/73 | 14 | 1015.2 | 15 | 350 | 62 | 69 | 5.1 |
| 8/ 6/73 | 15 | 1015.0 | 15 | 350 | 62 | 65 | 6.1 |
| 8/ 6/73 | 16 | 1014.8 | 16 | 350 | 60 | 70 | 7.1 |
| 8/ 6/73 | 17 | 1014.3 | 14 | 345 | 59 | 74 | 7.8 |
| 8/ 6/73 | 18 | 1014.2 | 15 | 355 | 56 | 80 | 8.0 |
| 8/ 6/73 | 19 | 1014.3 | 11 | 5 | 57 | 85 | 7.7 |
| 8/ 6/73 | 20 | 1014.5 | 9 | 10 | 57 | 84 | 6.7 |
| 8/ 6/73 | 21 | 1014.8 | 7 | 15 | 57 | 84 | 5.5 |
| 8/ 6/73 | 22 | 1014.9 | 7 | 10 | 57 | 84 | 4.1 |
| 8/ 6/73 | 23 | 1014.9 | 5 | 20 | 57 | 84 | 2.8 |
| 8/ 6/73 | 24 | 1014.9 | 3 | 340 | 58 | 85 | 1.7 |
| 8/ 7/73 | 1 | 1014.9 | 3 | 295 | 56 | 88 | 1.3 |
| 8/ 7/73 | 2 | 1014.9 | 2 | 300 | 56 | 89 | 1.4 |
| 8/ 7/73 | 3 | 1014.8 | 2 | 20 | 56 | 89 | 2.1 |
| 8/ 7/73 | 4 | 1014.9 | 2 | 320 | 54 | 89 | 3.0 |
| 8/ 7/73 | 5 | 1015.0 | 0 | 345 | 54 | 90 | 4.1 |
| 8/ 7/73 | 6 | 1015.0 | 1 | 290 | 53 | 90 | 4.9 |
| 8/ 7/73 | 7 | 1015.2 | 2 | 200 | 54 | 90 | 5.5 |
| 8/ 7/73 | 8 | 1015.8 | 1 | 235 | 56 | 90 | 5.6 |
| 8/ 7/73 | 9 | 1016.0 | 3 | 280 | 58 | 87 | 5.5 |
| 8/ 7/73 | 10 | 1016.0 | 2 | 290 | 58 | 87 | 5.1 |
| 8/ 7/73 | 11 | 1016.2 | 1 | 315 | 58 | 87 | 4.6 |
| 8/ 7/73 | 12 | 1016.2 | 3 | 315 | 60 | 80 | 4.3 |
| 8/ 7/73 | 13 | 1016.3 | 3 | 320 | 63 | 70 | 4.3 |
| 8/ 7/73 | 14 | 1016.1 | 2 | 325 | 62 | 71 | 4.7 |
| 8/ 7/73 | 15 | 1016.0 | 5 | 310 | 60 | 72 | 5.4 |
| 8/ 7/73 | 16 | 1015.7 | 7 | 310 | 62 | 76 | 6.2 |
| 8/ 7/73 | 17 | 1015.6 | 4 | 300 | 60 | 74 | 7.1 |
| 8/ 7/73 | 18 | 1015.6 | 3 | 300 | 58 | 78 | 7.8 |
| 8/ 7/73 | 19 | 1015.5 | 1 | 350 | 56 | 84 | 8.0 |
| 8/ 7/73 | 20 | 1015.7 | 0 | 285 | 56 | 85 | 7.6 |
| 8/ 7/73 | 21 | 1015.9 | 0 | 210 | 56 | 86 | 6.7 |
| 8/ 7/73 | 22 | 1016.0 | 1 | 0 | 56 | 86 | 5.5 |
| 8/ 7/73 | 23 | 1016.0 | 0 | 300 | 56 | 85 | 4.0 |
| 8/ 7/73 | 24 | 1016.1 | 1 | 260 | 56 | 86 | 2.6 |
| 8/ 8/73 | 1 | 1016.1 | 4 | 15 | 56 | 86 | 1.6 |
| 8/ 8/73 | 2 | 1016.1 | 2 | 350 | 56 | 87 | 1.1 |
| 8/ 8/73 | 3 | 1016.1 | 4 | 0 | 56 | 87 | 1.2 |
| 8/ 8/73 | 4 | 1016.1 | 4 | 10 | 56 | 89 | 1.8 |
| 8/ 8/73 | 5 | 1016.1 | 5 | 10 | 55 | 90 | 2.8 |
| 8/ 8/73 | 6 | 1016.2 | 4 | 5 | 56 | 90 | 3.9 |
| 8/ 8/73 | 7 | 1016.3 | 6 | 5 | 56 | 89 | 4.9 |
| 8/ 8/73 | 8 | 1016.8 | 5 | 345 | 57 | 88 | 5.6 |
| 8/ 8/73 | 9 | 1017.0 | 5 | 345 | 58 | 85 | 5.9 |
| 8/ 8/73 | 10 | 1017.1 | 6 | 355 | 59 | 80 | 5.7 |
| 8/ 8/73 | 11 | 1017.7 | 9 | 350 | 61 | 75 | 5.4 |
| 8/ 8/73 | 12 | 1017.6 | 7 | 340 | 62 | 72 | 5.0 |
| 8/ 8/73 | 13 | 1017.5 | 12 | 350 | 62 | 74 | 4.5 |
| 8/ 8/73 | 14 | 1017.3 | 12 | 345 | 67 | 76 | 4.5 |
| 8/ 8/73 | 15 | 1017.0 | 13 | 340 | 60 | 80 | 4.7 |
| 8/ 8/73 | 16 | 1016.8 | 7 | 330 | 59 | 85 | 5.4 |
| 8/ 8/73 | 17 | 1016.7 | 4 | 305 | 57 | 85 | 6.2 |
| 8/ 8/73 | 18 | 1016.7 | 2 | 245 | 56 | 87 | 7.1 |
| 8/ 8/73 | 19 | 1016.6 | 3 | 300 | 55 | 90 | 7.7 |
| 8/ 8/73 | 20 | 1016.7 | 3 | 325 | 55 | 90 | 8.0 |
| 8/ 8/73 | 21 | 1016.9 | 3 | 320 | 53 | 90 | 7.6 |
| 8/ 8/73 | 22 | 1016.9 | 0 | 205 | 53 | 90 | 6.7 |
| 8/ 8/73 | 23 | 1017.0 | 0 | 15 | 53 | 90 | 5.4 |
| 8/ 8/73 | 24 | 1017.1 | 0 | 335 | 53 | 90 | 3.9 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 8/ 9/73 | 1 | 1017.2 | 3 | 205 | 53 | 90 | 2.3 |
| 8/ 9/73 | 2 | 1017.5 | 3 | 195 | 53 | 90 | 1.1 |
| 8/ 9/73 | 3 | 1017.7 | 0 | 190 | 53 | 90 | 0.8 |
| 8/ 9/73 | 4 | 1017.7 | 3 | 205 | 54 | 90 | 0.9 |
| 8/ 9/73 | 5 | 1017.4 | 4 | 355 | 54 | 90 | 1.7 |
| 8/ 9/73 | 6 | 1018.0 | 6 | 220 | 54 | 90 | 2.7 |
| 8/ 9/73 | 7 | 1018.7 | 3 | 255 | 55 | 90 | 3.9 |
| 8/ 9/73 | 8 | 1019.3 | 2 | 210 | 55 | 90 | 5.0 |
| 8/ 9/73 | 9 | 1019.5 | 6 | 320 | 56 | 90 | 5.9 |
| 8/ 9/73 | 10 | 1019.4 | 4 | 325 | 56 | 89 | 6.2 |
| 8/ 9/73 | 11 | 1019.5 | 4 | 320 | 54 | 89 | 6.0 |
| 8/ 9/73 | 12 | 1019.6 | 1 | 345 | 54 | 89 | 5.6 |
| 8/ 9/73 | 13 | 1019.7 | 7 | 325 | 56 | 88 | 5.0 |
| 8/ 9/73 | 14 | 1019.8 | 9 | 355 | 59 | 82 | 4.5 |
| 8/ 9/73 | 15 | 1020.0 | 8 | 355 | 62 | 74 | 4.4 |
| 8/ 9/73 | 16 | 1020.0 | 1 | 330 | 62 | 72 | 4.6 |
| 8/ 9/73 | 17 | 1020.0 | 2 | 240 | 59 | 80 | 5.3 |
| 8/ 9/73 | 18 | 1019.8 | 4 | 195 | 56 | 88 | 6.2 |
| 8/ 9/73 | 19 | 1020.0 | 3 | 200 | 55 | 88 | 7.1 |
| 8/ 9/73 | 20 | 1020.3 | 1 | 190 | 54 | 88 | 7.9 |
| 8/ 9/73 | 21 | 1020.5 | 2 | 195 | 54 | 88 | 8.1 |
| 8/ 9/73 | 22 | 1020.4 | 1 | 185 | 54 | 88 | 7.6 |
| 8/ 9/73 | 23 | 1020.4 | 0 | 275 | 54 | 88 | 6.4 |
| 8/ 9/73 | 24 | 1020.4 | 0 | 5 | 54 | 88 | 5.0 |
| 8/10/73 | 1 | 1020.4 | 1 | 0 | 56 | 82 | 3.2 |
| 8/10/73 | 2 | 1020.4 | 1 | 10 | 55 | 80 | 1.7 |
| 8/10/73 | 3 | 1020.4 | 4 | 25 | 56 | 77 | 0.7 |
| 8/10/73 | 4 | 1020.4 | 3 | 345 | 57 | 77 | 0.2 |
| 8/10/73 | 5 | 1020.7 | 3 | 345 | 57 | 76 | 0.6 |
| 8/10/73 | 6 | 1021.0 | 4 | 5 | 57 | 74 | 1.4 |
| 8/10/73 | 7 | 1021.3 | 6 | 5 | 58 | 74 | 2.7 |
| 8/10/73 | 8 | 1021.6 | 5 | 5 | 59 | 66 | 4.2 |
| 8/10/73 | 9 | 1021.8 | 8 | 360 | 60 | 66 | 5.4 |
| 8/10/73 | 10 | 1021.8 | 9 | 355 | 61 | 62 | 6.2 |
| 8/10/73 | 11 | 1021.7 | 10 | 355 | 62 | 60 | 6.3 |
| 8/10/73 | 12 | 1021.5 | 10 | 350 | 62 | 57 | 6.0 |
| 8/10/73 | 13 | 1021.4 | 11 | 335 | 63 | 57 | 5.3 |
| 8/10/73 | 14 | 1021.3 | 12 | 340 | 63 | 57 | 4.7 |
| 8/10/73 | 15 | 1020.8 | 10 | 345 | 63 | 55 | 4.1 |
| 8/10/73 | 16 | 1020.3 | 10 | 345 | 62 | 56 | 3.9 |
| 8/10/73 | 17 | 1020.0 | 9 | 350 | 61 | 56 | 4.4 |
| 8/10/73 | 18 | 1019.7 | 10 | 345 | 60 | 63 | 5.2 |
| 8/10/73 | 19 | 1019.6 | 7 | 350 | 58 | 68 | 6.2 |
| 8/10/73 | 20 | 1019.7 | 11 | 355 | 57 | 73 | 7.3 |
| 8/10/73 | 21 | 1019.8 | 9 | 345 | 56 | 75 | 7.9 |
| 8/10/73 | 22 | 1019.5 | 9 | 345 | 54 | 81 | 8.1 |
| 8/10/73 | 23 | 1019.3 | 5 | 5 | 52 | 85 | 7.4 |
| 8/10/73 | 24 | 1019.3 | 6 | 355 | 50 | 88 | 6.1 |
| 8/11/73 | 1 | 1019.2 | 5 | 10 | 48 | 88 | 4.4 |
| 8/11/73 | 2 | 1018.9 | 3 | 45 | 48 | 89 | 2.6 |
| 8/11/73 | 3 | 1018.7 | 1 | 25 | 49 | 89 | 1.0 |
| 8/11/73 | 4 | 1018.6 | 3 | 10 | 50 | 89 | -0.0 |
| 8/11/73 | 5 | 1018.7 | 0 | 50 | 51 | 89 | -0.2 |
| 8/11/73 | 6 | 1018.8 | 9 | 10 | 52 | 89 | 0.4 |
| 8/11/73 | 7 | 1018.8 | 4 | 355 | 53 | 87 | 1.6 |
| 8/11/73 | 8 | 1018.8 | 6 | 5 | 54 | 87 | 3.1 |
| 8/11/73 | 9 | 1018.6 | 9 | 0 | 56 | 87 | 4.7 |
| 8/11/73 | 10 | 1018.3 | 12 | 355 | 59 | 73 | 5.8 |
| 8/11/73 | 11 | 1017.9 | 14 | 350 | 59 | 70 | 6.5 |
| 8/11/73 | 12 | 1017.4 | 14 | 350 | 60 | 70 | 6.6 |
| 8/11/73 | 13 | 1016.8 | 17 | 350 | 60 | 70 | 5.9 |
| 8/11/73 | 14 | 1016.5 | 14 | 350 | 61 | 70 | 5.1 |
| 8/11/73 | 15 | 1016.0 | 13 | 350 | 61 | 72 | 4.2 |
| 8/11/73 | 16 | 1015.5 | 13 | 355 | 60 | 77 | 3.7 |
| 8/11/73 | 17 | 1015.0 | 13 | 355 | 59 | 80 | 3.6 |
| 8/11/73 | 18 | 1014.7 | 14 | 0 | 58 | 85 | 4.2 |
| 8/11/73 | 19 | 1014.5 | 16 | 0 | 56 | 88 | 5.3 |
| 8/11/73 | 20 | 1014.7 | 15 | 355 | 54 | 88 | 6.4 |
| 8/11/73 | 21 | 1014.9 | 12 | 340 | 53 | 88 | 7.7 |
| 8/11/73 | 22 | 1014.9 | 10 | 350 | 53 | 88 | 8.2 |
| 8/11/73 | 23 | 1014.9 | 9 | 350 | 53 | 88 | 8.1 |
| 8/11/73 | 24 | 1014.9 | 9 | 345 | 52 | 88 | 7.2 |

| DATE | HOUR | BP | WS | WD | TA | HUM | TIDE |
|---|---|---|---|---|---|---|---|
| 8/12/73 | 1 | 1014.7 | 10 | 360 | 52 | 88 | 5.6 |
| 8/12/73 | 2 | 1014.8 | 8 | 350 | 52 | 88 | 3.7 |
| 8/12/73 | 3 | 1013.5 | 8 | 355 | 52 | 88 | 1.7 |
| 8/12/73 | 4 | 1013.5 | 5 | 35 | 52 | 88 | 0.3 |
| 8/12/73 | 5 | 1013.7 | 1 | 305 | 52 | 88 | -0.2 |
| 8/12/73 | 6 | 1014.3 | 5 | 310 | 52 | 88 | -0.1 |
| 8/12/73 | 7 | 1014.4 | 5 | 270 | 53 | 88 | 0.8 |
| 8/12/73 | 8 | 1014.8 | 2 | 235 | 53 | 88 | 2.3 |
| 8/12/73 | 9 | 1015.2 | 2 | 240 | 54 | 88 | 4.0 |
| 8/12/73 | 10 | 1015.1 | 6 | 240 | 56 | 85 | 5.6 |
| 8/12/73 | 11 | 1015.1 | 4 | 225 | 57 | 75 | 6.6 |
| 8/12/73 | 12 | 1015.0 | 4 | 230 | 59 | 76 | 7.1 |
| 8/12/73 | 13 | 1014.9 | 5 | 220 | 59 | 76 | 6.6 |
| 8/12/73 | 14 | 1014.9 | 6 | 210 | 60 | 78 | 5.7 |
| 8/12/73 | 15 | 1014.9 | 8 | 200 | 59 | 83 | 4.5 |
| 8/12/73 | 16 | 1015.2 | 9 | 200 | 58 | 80 | 3.5 |
| 8/12/73 | 17 | 1015.0 | 9 | 210 | 58 | 83 | 3.1 |
| 8/12/73 | 18 | 1014.8 | 9 | 200 | 57 | 85 | 3.5 |
| 8/12/73 | 19 | 1015.0 | 10 | 195 | 56 | 88 | 4.4 |
| 8/12/73 | 20 | 1015.2 | 9 | 195 | 56 | 88 | 5.6 |
| 8/12/73 | 21 | 1016.0 | 6 | 195 | 56 | 88 | 6.0 |
| 8/12/73 | 22 | 1016.0 | 5 | 190 | 56 | 88 | 8.1 |
| 8/12/73 | 23 | 1016.1 | 5 | 195 | 55 | 88 | 8.5 |
| 8/12/73 | 24 | 1016.2 | 4 | 185 | 56 | 88 | 8.1 |
| 8/13/73 | 1 | 1016.3 | 6 | 195 | 56 | 88 | 6.7 |
| 8/13/73 | 2 | 1016.4 | 5 | 195 | 56 | 88 | 5.1 |
| 8/13/73 | 3 | 1016.5 | 5 | 200 | 55 | 88 | 2.9 |
| 8/13/73 | 4 | 1016.6 | 6 | 195 | 55 | 88 | 1.1 |
| 8/13/73 | 5 | 1016.8 | 5 | 185 | 55 | 88 | -0.2 |
| 8/13/73 | 6 | 1017.4 | 3 | 190 | 55 | 88 | -0.4 |
| 8/13/73 | 7 | 1018.2 | 7 | 195 | 55 | 88 | 0.1 |
| 8/13/73 | 8 | 1018.5 | 7 | 200 | 56 | 94 | 1.5 |
| 8/13/73 | 9 | 1018.8 | 2 | 210 | 57 | 94 | 3.3 |
| 8/13/73 | 10 | 1019.2 | 3 | 210 | 58 | 94 | 5.0 |
| 8/13/73 | 11 | 1019.7 | 1 | 250 | 57 | 92 | 6.5 |
| 8/13/73 | 12 | 1019.8 | 0 | 290 | 58 | 90 | 7.2 |
| 8/13/73 | 13 | 1020.0 | 1 | 310 | 60 | 85 | 7.2 |
| 8/13/73 | 14 | 1019.8 | 2 | 305 | 63 | 80 | 6.1 |
| 8/13/73 | 15 | 1019.6 | 1 | 350 | 62 | 83 | 5.0 |
| 8/13/73 | 16 | 1019.4 | 5 | 345 | 60 | 85 | 3.7 |
| 8/13/73 | 17 | 1019.2 | 7 | 350 | 62 | 85 | 2.7 |
| 8/13/73 | 18 | 1018.9 | 8 | 355 | 60 | 86 | 2.5 |
| 8/13/73 | 19 | 1018.9 | 13 | 355 | 58 | 87 | 3.1 |
| 8/13/73 | 20 | 1018.9 | 10 | 345 | 57 | 88 | 4.4 |
| 8/13/73 | 21 | 1019.0 | 11 | 355 | 57 | 88 | 5.7 |
| 8/13/73 | 22 | 1019.0 | 11 | 355 | 57 | 88 | 7.2 |
| 8/13/73 | 23 | 1019.0 | 9 | 355 | 56 | 88 | 8.2 |
| 8/13/73 | 24 | 1019.1 | 11 | 0 | 55 | 88 | 8.3 |
| 8/14/73 | 1 | 1019.1 | 12 | 0 | 55 | 88 | 7.5 |
| 8/14/73 | 2 | 1019.1 | 4 | 10 | 54 | 88 | 5.8 |
| 8/14/73 | 3 | 1019.2 | 10 | 355 | 52 | 90 | 4.0 |
| 8/14/73 | 4 | 1019.3 | 3 | 10 | 50 | 92 | 1.9 |
| 8/14/73 | 5 | 1019.4 | 5 | 355 | 49 | 92 | 0.1 |
| 8/14/73 | 6 | 1019.5 | 3 | 20 | 48 | 92 | -0.6 |
| 8/14/73 | 7 | 1020.0 | 5 | 350 | 50 | 92 | -0.6 |
| 8/14/73 | 8 | 1020.2 | 10 | 350 | 56 | 82 | 0.6 |
| 8/14/73 | 9 | 1020.2 | 12 | 345 | 58 | 74 | 2.2 |
| 8/14/73 | 10 | 1020.2 | 17 | 350 | 60 | 69 | 4.1 |
| 0/14/73 | 11 | 1020.1 | 17 | 345 | 60 | 67 | 5.8 |
| 8/14/73 | 12 | 1019.7 | 18 | 345 | 61 | 67 | 7.0 |
| 8/14/73 | 13 | 1019.7 | 17 | 350 | 62 | 66 | 7.4 |
| 8/14/73 | 14 | 1019.2 | 17 | 345 | 61 | 66 | 6.7 |
| 8/14/73 | 15 | 1018.9 | 16 | 345 | 61 | 66 | 5.4 |
| 8/14/73 | 16 | 1018.5 | 18 | 355 | 60 | 66 | 4.1 |
| 8/14/73 | 17 | 1018.0 | 20 | 355 | 60 | 68 | 2.7 |
| 8/14/73 | 18 | 1017.7 | 18 | 0 | 58 | 70 | 2.0 |
| 8/14/73 | 19 | 1017.7 | 16 | 0 | 56 | 75 | 1.9 |
| 8/14/73 | 20 | 1017.7 | 17 | 5 | 55 | 78 | 2.9 |
| 8/14/73 | 21 | 1017.9 | 19 | 0 | 54 | 82 | 4.4 |
| 8/14/73 | 22 | 1017.9 | 12 | 355 | 52 | 84 | 5.9 |
| 8/14/73 | 23 | 1017.8 | 14 | 360 | 50 | 85 | 7.2 |
| 8/14/73 | 24 | 1017.9 | 12 | 350 | 48 | 90 | 8.1 |

## WAVE DATA

| DATE | HOUR | T | H10 | H3 |
|---|---|---|---|---|
| 7/ 1/73 | 1 | 7.43 | 5.1 | 4.0 |
| 7/ 1/73 | 7 | 7.46 | 4.8 | 3.7 |
| 7/ 1/73 | 13 | 7.53 | 3.3 | 2.6 |
| 7/ 1/73 | 19 | 6.80 | 3.0 | 2.3 |
| 7/ 2/73 | 1 | 6.62 | 2.2 | 1.7 |
| 7/ 2/73 | 7 | 6.78 | 2.4 | 1.9 |
| 7/ 2/73 | 13 | 6.40 | 1.5 | 1.2 |
| 7/ 2/73 | 19 | 6.64 | 1.5 | 1.2 |
| 7/ 3/73 | 1 | 7.82 | 3.5 | 2.7 |
| 7/ 3/73 | 7 | 8.43 | 3.6 | 2.8 |
| 7/ 3/73 | 13 | 7.74 | 3.0 | 2.3 |
| 7/ 3/73 | 19 | 7.67 | 3.6 | 2.8 |
| 7/ 4/73 | 1 | 7.48 | 2.2 | 1.7 |
| 7/ 4/73 | 7 | 7.10 | 2.0 | 1.6 |
| 7/ 4/73 | 13 | 6.82 | 2.4 | 1.9 |
| 7/ 4/73 | 19 | 7.21 | 2.5 | 2.0 |
| 7/ 5/73 | 1 | 7.13 | 2.5 | 2.0 |
| 7/ 5/73 | 7 | 7.64 | 2.5 | 2.0 |
| 7/ 5/73 | 13 | 7.84 | 3.1 | 2.4 |
| 7/ 5/73 | 19 | 7.18 | 3.0 | 2.3 |
| 7/ 6/73 | 1 | 8.25 | 3.0 | 2.3 |
| 7/ 6/73 | 7 | 6.79 | 2.4 | 1.9 |
| 7/ 6/73 | 13 | 6.24 | 2.0 | 1.6 |
| 7/ 6/73 | 19 | 8.90 | 3.8 | 3.0 |
| 7/ 7/73 | 1 | 7.93 | 3.0 | 2.3 |
| 7/ 7/73 | 7 | 7.31 | 4.2 | 3.4 |
| 7/ 7/73 | 13 | 8.66 | 4.7 | 3.8 |
| 7/ 7/73 | 19 | 7.61 | 4.0 | 3.2 |
| 7/ 8/73 | 1 | 7.79 | 3.9 | 3.1 |
| 7/ 8/73 | 7 | 7.10 | 3.8 | 3.0 |
| 7/ 8/73 | 13 | 8.41 | 4.7 | 3.8 |
| 7/ 8/73 | 19 | 8.37 | 5.5 | 4.8 |
| 7/ 8/73 | 1 | 8.33 | 3.8 | 3.0 |
| 7/ 9/73 | 7 | 8.85 | 5.0 | 4.0 |
| 7/ 9/73 | 13 | 7.59 | 4.3 | 3.4 |
| 7/ 9/73 | 19 | 8.84 | 3.6 | 2.8 |
| 7/10/73 | 1 | 8.50 | 3.7 | 2.8 |
| 7/10/73 | 7 | 6.88 | 2.4 | 1.9 |
| 7/10/73 | 13 | 6.79 | 2.0 | 1.6 |
| 7/10/73 | 19 | 6.89 | 3.0 | 2.4 |
| 7/11/73 | 1 | 6.49 | 3.3 | 2.6 |
| 7/11/73 | 7 | 7.55 | 5.0 | 4.0 |
| 7/11/73 | 13 | 7.50 | 4.8 | 3.8 |
| 7/11/73 | 19 | 6.72 | 5.8 | 4.7 |
| 7/12/73 | 1 | 7.13 | 5.5 | 4.4 |
| 7/12/73 | 7 | 7.41 | 5.7 | 4.6 |
| 7/12/73 | 13 | 7.78 | 6.7 | 5.0 |
| 7/12/73 | 19 | 8.03 | 5.3 | 4.2 |
| 7/13/73 | 1 | 8.10 | 5.4 | 4.3 |
| 7/13/73 | 7 | 7.56 | 5.8 | 4.6 |
| 7/13/73 | 13 | 7.81 | 6.0 | 4.8 |
| 7/13/73 | 19 | 8.39 | 7.1 | 5.7 |
| 7/14/73 | 1 | 8.26 | 7.3 | 5.8 |
| 7/14/73 | 7 | 7.48 | 5.0 | 4.0 |
| 7/14/73 | 13 | 7.59 | 5.0 | 4.0 |
| 7/14/73 | 19 | 7.54 | 5.2 | 4.2 |
| 7/15/73 | 1 | 7.04 | 4.6 | 3.7 |
| 7/15/73 | 7 | 8.02 | 6.2 | 4.9 |
| 7/15/73 | 13 | 7.52 | 5.1 | 4.1 |
| 7/15/73 | 19 | 8.76 | 6.3 | 5.1 |

| DATE | HOUR | T | H10 | H3 |
|---|---|---|---|---|
| 7/16/73 | 1 | 8.40 | 8.1 | 6.4 |
| 7/16/73 | 7 | 7.92 | 6.0 | 4.8 |
| 7/16/73 | 13 | 8.56 | 8.2 | 6.5 |
| 7/16/73 | 19 | 8.87 | 7.1 | 5.6 |
| 7/17/73 | 1 | 8.01 | 5.9 | 4.7 |
| 7/17/73 | 7 | 8.22 | 6.2 | 4.9 |
| 7/17/73 | 13 | 7.23 | 4.9 | 3.9 |
| 7/17/73 | 19 | 8.45 | 5.2 | 4.1 |
| 7/18/73 | 1 | 9.00 | 5.8 | 4.6 |
| 7/18/73 | 7 | 7.38 | 3.9 | 3.1 |
| 7/18/73 | 13 | 8.05 | 2.4 | 1.9 |
| 7/18/73 | 19 | 8.71 | 4.5 | 3.6 |
| 7/19/73 | 1 | 8.60 | 4.5 | 3.6 |
| 7/19/73 | 7 | 8.14 | 3.4 | 2.7 |
| 7/19/73 | 13 | 8.29 | 4.2 | 3.3 |
| 7/19/73 | 19 | 6.61 | 2.4 | 1.9 |
| 7/20/73 | 1 | 7.92 | 2.5 | 2.0 |
| 7/20/73 | 7 | 7.54 | 2.9 | 2.3 |
| 7/20/73 | 13 | 7.00 | 2.9 | 2.3 |
| 7/20/73 | 19 | 6.52 | 2.3 | 1.8 |
| 7/21/73 | 1 | 6.98 | 2.6 | 2.0 |
| 7/21/73 | 7 | 5.72 | 2.0 | 1.6 |
| 7/21/73 | 13 | 7.39 | 2.5 | 1.9 |
| 7/21/73 | 19 | 6.66 | 2.2 | 1.7 |
| 7/22/73 | 1 | 6.56 | 2.1 | 1.6 |
| 7/22/73 | 7 | 6.46 | 2.1 | 1.6 |
| 7/22/73 | 13 | 8.37 | 2.5 | 1.9 |
| 7/22/73 | 19 | 8.74 | 2.2 | 1.7 |
| 7/23/73 | 1 | 8.83 | 2.5 | 1.9 |
| 7/23/73 | 7 | 7.68 | 2.5 | 1.9 |
| 7/23/73 | 13 | 6.54 | 2.4 | 1.8 |
| 7/23/73 | 19 | 8.06 | 3.0 | 2.3 |
| 7/24/73 | 1 | 8.36 | 2.0 | 1.6 |
| 7/24/73 | 7 | 7.33 | 2.4 | 1.9 |
| 7/24/73 | 13 | 7.36 | 2.3 | 1.8 |
| 7/24/73 | 19 | 8.50 | 2.0 | 1.6 |
| 7/25/73 | 1 | 8.60 | 2.1 | 1.6 |
| 7/25/73 | 7 | 8.71 | 3.5 | 2.7 |
| 7/25/73 | 13 | 8.41 | 3.5 | 2.7 |
| 7/25/73 | 19 | 7.02 | 3.0 | 2.3 |
| 7/26/73 | 1 | 6.11 | 2.2 | 1.7 |
| 7/26/73 | 7 | 5.93 | 2.8 | 2.2 |
| 7/26/73 | 13 | 5.96 | 3.0 | 2.3 |
| 7/26/73 | 19 | 6.93 | 5.2 | 4.0 |
| 7/27/73 | 1 | 6.52 | 3.4 | 2.6 |
| 7/27/73 | 7 | 6.64 | 3.6 | 2.8 |
| 7/27/73 | 13 | 6.31 | 2.8 | 2.2 |
| 7/27/73 | 19 | 5.60 | 1.9 | 1.5 |
| 7/28/73 | 1 | 5.88 | 1.9 | 1.5 |
| 7/28/73 | 7 | 6.14 | 2.3 | 1.8 |
| 7/28/73 | 13 | 6.05 | 2.0 | 1.6 |
| 7/28/73 | 19 | 5.72 | 2.0 | 1.6 |
| 7/29/73 | 1 | 6.23 | 3.1 | 2.4 |
| 7/29/73 | 7 | 6.19 | 2.3 | 1.8 |
| 7/29/73 | 13 | 6.99 | 3.0 | 2.3 |
| 7/29/73 | 19 | 5.68 | 1.9 | 1.5 |
| 7/30/73 | 1 | 5.24 | 2.2 | 1.7 |
| 7/30/73 | 7 | 6.57 | 2.3 | 1.8 |
| 7/30/73 | 13 | 7.60 | 2.5 | 1.9 |
| 7/30/73 | 19 | 5.60 | 1.8 | 1.4 |

| DATE | HOUR | T | H10 | H3 |
|---|---|---|---|---|
| 7/31/73 | 1 | 6.02 | 2.2 | 1.7 |
| 7/31/73 | 7 | 5.60 | 2.1 | 1.6 |
| 7/31/73 | 13 | 6.50 | 3.5 | 2.7 |
| 7/31/73 | 19 | 5.68 | 2.0 | 1.6 |
| 8/ 1/73 | 1 | 5.61 | 2.4 | 1.8 |
| 8/ 1/73 | 7 | 5.85 | 2.0 | 1.6 |
| 8/ 1/73 | 13 | 5.66 | 1.9 | 1.5 |
| 8/ 1/73 | 19 | 5.91 | 2.1 | 1.6 |
| 8/ 2/73 | 1 | 6.58 | 2.7 | 2.1 |
| 8/ 2/73 | 7 | 6.08 | 3.0 | 2.3 |
| 8/ 2/73 | 13 | 6.24 | 2.1 | 1.6 |
| 8/ 2/73 | 19 | 6.13 | 2.0 | 1.6 |
| 8/ 3/73 | 1 | 6.70 | 3.0 | 2.3 |
| 8/ 3/73 | 7 | 7.13 | 3.6 | 2.8 |
| 8/ 3/73 | 13 | 7.40 | 3.7 | 2.9 |
| 8/ 3/73 | 19 | 6.66 | 2.7 | 2.1 |
| 8/ 4/73 | 1 | 7.26 | 2.6 | 2.1 |
| 8/ 4/73 | 7 | 7.03 | 3.3 | 2.6 |
| 8/ 4/73 | 13 | 6.80 | 2.5 | 2.0 |
| 8/ 4/73 | 19 | 6.06 | 1.9 | 1.5 |
| 8/ 5/73 | 1 | 6.56 | 2.9 | 2.3 |
| 8/ 5/73 | 7 | 7.40 | 3.5 | 3.1 |
| 8/ 5/73 | 13 | 7.60 | 3.6 | 2.8 |
| 8/ 5/73 | 19 | 8.03 | 3.6 | 2.8 |
| 8/ 6/73 | 1 | 7.70 | 3.7 | 2.9 |
| 8/ 6/73 | 7 | 7.96 | 4.9 | 3.8 |
| 8/ 6/73 | 13 | 8.10 | 5.6 | 4.3 |
| 8/ 6/73 | 19 | 8.16 | 5.4 | 4.2 |
| 8/ 7/73 | 1 | 8.63 | 5.2 | 4.1 |
| 8/ 7/73 | 7 | 8.50 | 5.2 | 4.1 |
| 8/ 7/73 | 13 | 7.60 | 3.8 | 3.0 |
| 8/ 7/73 | 19 | 7.23 | 2.9 | 2.3 |
| 8/ 8/73 | 1 | 7.70 | 3.2 | 2.5 |
| 8/ 8/73 | 7 | 7.46 | 2.6 | 2.0 |
| 8/ 8/73 | 13 | 7.20 | 2.6 | 2.0 |
| 8/ 8/73 | 19 | 7.86 | 2.9 | 2.3 |
| 8/ 9/73 | 1 | 7.00 | 3.2 | 2.5 |
| 8/ 9/73 | 7 | 6.30 | 3.2 | 2.5 |
| 8/ 9/73 | 13 | 7.50 | 3.6 | 2.8 |
| 8/ 9/73 | 19 | 7.66 | 3.0 | 2.3 |
| 8/10/73 | 1 | 8.13 | 3.8 | 3.0 |
| 8/10/73 | 7 | 7.90 | 3.8 | 2.9 |
| 8/10/73 | 13 | 8.20 | 4.1 | 3.2 |
| 8/10/73 | 19 | 8.33 | 4.0 | 3.1 |
| 8/11/73 | 1 | 8.66 | 5.0 | 3.9 |
| 8/11/73 | 7 | 7.93 | 2.8 | 2.2 |
| 8/11/73 | 13 | 8.56 | 3.6 | 2.8 |
| 8/11/73 | 19 | 8.10 | 4.5 | 3.5 |
| 8/12/73 | 1 | 8.06 | 4.8 | 3.7 |
| 8/12/73 | 7 | 7.63 | 3.7 | 2.9 |
| 8/12/73 | 13 | 7.96 | 3.7 | 2.9 |
| 8/12/73 | 19 | 7.56 | 3.6 | 2.8 |
| 8/13/73 | 1 | 7.40 | 3.1 | 2.4 |
| 8/13/73 | 7 | 7.76 | 3.5 | 2.7 |
| 8/13/73 | 13 | 8.23 | 4.6 | 3.6 |
| 8/13/73 | 19 | 8.30 | 4.1 | 3.2 |
| 8/14/73 | 1 | 8.80 | 4.0 | 3.2 |
| 8/14/73 | 7 | 7.70 | 3.9 | 3.0 |
| 8/14/73 | 13 | 7.23 | 4.1 | 3.2 |
| 8/14/73 | 19 | 7.23 | 3.0 | 2.3 |

| DATE | HOUR | TIDE | AZI | SPEED | ON | AL |
|---|---|---|---|---|---|---|
| 7/ 7/73 | 14 | 4.50 | 203.13 | 1.20 | -0.47 | 1.11 |
| 7/ 7/73 | 20 | 6.50 | 2.92 | 1.30 | 0.07 | -1.34 |
| 7/ 8/73 | 8 | 5.20 | 29.39 | 0.20 | 0.10 | -0.17 |
| 7/ 8/73 | 20 | 7.40 | 18.64 | 1.80 | 0.58 | -1.71 |
| 7/ 9/73 | 8 | 5.20 | 96.17 | 0.40 | 0.40 | 0.04 |
| 7/ 9/73 | 20 | 8.10 | 124.16 | 0.90 | 0.79 | 0.54 |
| 7/10/73 | 8 | 4.80 | 114.25 | 0.20 | 0.26 | 0.12 |
| 7/10/73 | 14 | 3.70 | 264.76 | 0.30 | -0.39 | 0.04 |
| 7/10/73 | 20 | 7.70 | 170.91 | 0.70 | 0.12 | 0.78 |
| 7/11/73 | 8 | 3.70 | 157.24 | 0.50 | 0.22 | 0.54 |
| 7/11/73 | 20 | 7.10 | 163.64 | 0.80 | 0.24 | 0.83 |
| 7/12/73 | 8 | 2.60 | 179.04 | 0.10 | 0.00 | 0.15 |
| 7/12/73 | 14 | 4.50 | 178.18 | 1.00 | 0.03 | 1.08 |
| 7/12/73 | 20 | 6.50 | 187.10 | 1.60 | -0.20 | 1.60 |
| 7/13/73 | 8 | 1.80 | 126.16 | 0.60 | 0.56 | 0.41 |
| 7/13/73 | 14 | 5.30 | 176.87 | 0.80 | 0.04 | 0.80 |
| 7/13/73 | 20 | 6.00 | 193.56 | 1.10 | -0.27 | 1.10 |
| 7/14/73 | 8 | 2.70 | 175.77 | 1.20 | 0.10 | 1.29 |
| 7/14/73 | 14 | 5.60 | 179.74 | 1.00 | 0.00 | 1.04 |
| 7/14/73 | 20 | 5.40 | 194.42 | 1.30 | -0.34 | 1.32 |
| 7/15/73 | 14 | 6.70 | 164.10 | 1.10 | 0.33 | 1.14 |
| 7/15/73 | 20 | 4.80 | 170.86 | 0.60 | 0.11 | 0.68 |
| 7/16/73 | 14 | 7.40 | 226.06 | 1.10 | -0.83 | 0.80 |
| 7/16/73 | 20 | 4.00 | 138.57 | 0.80 | 0.54 | 0.62 |
| 7/17/73 | 8 | -0.30 | 194.76 | 0.90 | -0.25 | 0.96 |
| 7/17/73 | 14 | 7.70 | 155.74 | 1.60 | 0.66 | 1.46 |
| 7/17/73 | 20 | 3.10 | 157.57 | 1.40 | 0.54 | 1.32 |
| 7/18/73 | 7 | 0.20 | 174.45 | 1.10 | 0.12 | 1.19 |
| 7/18/73 | 14 | 7.70 | 164.22 | 1.80 | 0.49 | 1.74 |
| 7/18/73 | 20 | 2.80 | 218.67 | 0.40 | -0.31 | 0.38 |
| 7/19/73 | 8 | 0.20 | 214.28 | 0.90 | -0.56 | 0.82 |
| 7/19/73 | 20 | 2.70 | 45.10 | 0.90 | 0.70 | -0.69 |
| 7/20/73 | 8 | 1.00 | 98.01 | 0.40 | 0.48 | 0.07 |
| 7/20/73 | 20 | 3.10 | 19.27 | 1.00 | 0.34 | -0.98 |
| 7/21/73 | 8 | 2.10 | 6.96 | 0.50 | 0.06 | -0.53 |
| 7/21/73 | 14 | 6.40 | 352.54 | 0.80 | -0.11 | -0.87 |
| 7/21/73 | 20 | 4.00 | 0.64 | 0.80 | 0.01 | -0.88 |
| 7/22/73 | 8 | 3.20 | 342.61 | 0.60 | -0.18 | -0.57 |
| 7/22/73 | 14 | 5.80 | 301.12 | 0.00 | -0.08 | -0.05 |
| 7/22/73 | 20 | 5.30 | 32.99 | 0.20 | 0.12 | -0.18 |
| 7/23/73 | 8 | 4.50 | 8.30 | 1.10 | 0.17 | -1.18 |
| 7/23/73 | 20 | 6.40 | 134.16 | 1.10 | 0.82 | 0.79 |
| 7/24/73 | 8 | 5.20 | 30.46 | 0.30 | 0.20 | -0.33 |
| 7/24/73 | 20 | 7.70 | 191.40 | 0.70 | -0.15 | 0.77 |
| 7/25/73 | 8 | 5.30 | 347.92 | 0.70 | -0.15 | -0.69 |

| DATE | HOUR | TIDE | AZI | SPEED | ON | AL |
|---|---|---|---|---|---|---|
| 7/25/73 | 14 | 3.60 | 13.00 | 0.90 | 0.20 | -0.89 |
| 7/25/73 | 20 | 8.70 | 178.15 | 1.30 | 0.04 | 1.38 |
| 7/26/73 | 8 | 4.70 | 232.08 | 0.30 | -0.29 | 0.23 |
| 7/26/73 | 20 | 8.80 | 181.39 | 1.50 | -0.04 | 1.58 |
| 7/27/73 | 14 | 4.20 | 212.74 | 0.70 | -0.43 | 0.66 |
| 7/27/73 | 20 | 8.10 | 177.03 | 1.10 | 0.06 | 1.11 |
| 7/28/73 | 8 | 2.00 | 132.04 | 1.20 | 0.91 | 0.82 |
| 7/28/73 | 14 | 5.30 | 172.02 | 1.00 | 0.15 | 1.08 |
| 7/28/73 | 20 | 6.80 | 169.20 | 1.20 | 0.24 | 1.27 |
| 7/29/73 | 8 | 0.70 | 177.41 | 2.10 | 0.09 | 2.10 |
| 7/29/73 | 14 | 6.50 | 205.30 | 1.10 | -0.48 | 1.01 |
| 7/29/73 | 20 | 4.80 | 213.35 | 1.20 | -0.71 | 1.07 |
| 7/30/73 | 8 | -0.70 | 188.00 | 1.40 | -0.44 | 1.22 |
| 7/30/73 | 20 | 2.70 | 200.00 | 1.30 | -0.17 | 1.32 |
| 7/31/73 | 20 | 1.40 | 175.42 | 1.50 | 0.12 | 1.53 |
| 8/ 1/73 | 8 | -1.40 | 171.31 | 1.30 | 0.20 | 1.29 |
| 8/ 1/73 | 14 | 8.60 | 180.23 | 1.90 | -0.01 | 1.95 |
| 8/ 1/73 | 20 | 0.90 | 167.19 | 2.00 | 0.45 | 1.97 |
| 8/ 2/73 | 7 | 0.50 | 159.58 | 1.40 | 0.52 | 1.38 |
| 8/ 2/73 | 12 | 5.50 | 185.08 | 1.90 | -0.18 | 1.98 |
| 8/ 2/73 | 20 | 1.80 | 176.04 | 1.90 | 0.13 | 1.89 |
| 8/ 3/73 | 8 | 1.00 | 171.89 | 2.20 | 0.31 | 2.17 |
| 8/ 3/73 | 14 | 7.70 | 181.86 | 1.20 | -0.04 | 1.20 |
| 8/ 3/73 | 20 | 2.30 | 167.13 | 0.80 | 0.18 | 0.80 |
| 8/ 4/73 | 8 | 2.40 | 162.11 | 1.60 | 0.50 | 1.55 |
| 8/ 4/73 | 20 | 4.00 | 211.62 | 0.60 | -0.36 | 0.58 |
| 8/ 5/73 | 8 | 3.80 | 164.00 | 1.20 | 0.35 | 1.23 |
| 8/ 5/73 | 14 | 5.60 | 170.74 | 0.90 | 0.16 | 0.96 |
| 8/ 5/73 | 20 | 5.50 | 200.97 | 0.90 | -0.33 | 0.86 |
| 8/ 6/73 | 8 | 5.00 | 191.28 | 1.60 | -0.31 | 1.57 |
| 8/ 6/73 | 20 | 6.70 | 139.28 | 0.40 | 0.28 | 0.33 |
| 8/ 7/73 | 8 | 5.60 | 213.52 | 0.70 | -0.43 | 0.64 |
| 8/ 7/73 | 20 | 7.60 | 178.51 | 0.70 | 0.02 | 0.74 |
| 8/ 8/73 | 8 | 5.60 | 188.84 | 1.00 | -0.15 | 0.99 |
| 8/ 8/73 | 14 | 4.50 | 170.22 | 1.30 | 0.22 | 1.28 |
| 8/ 8/73 | 20 | 8.00 | 203.48 | 1.20 | -0.51 | 1.18 |
| 8/ 9/73 | 8 | 5.00 | 173.37 | 1.40 | 0.17 | 1.46 |
| 8/ 9/73 | 14 | 4.50 | 161.84 | 2.10 | 0.66 | 2.00 |
| 8/ 9/73 | 20 | 7.90 | 194.41 | 1.60 | -0.41 | 1.58 |
| 8/10/73 | 8 | 4.20 | 168.85 | 2.10 | 0.42 | 2.13 |
| 8/10/73 | 14 | 4.70 | 169.24 | 3.10 | 0.59 | 3.09 |
| 8/10/73 | 20 | 7.30 | 183.06 | 1.40 | -0.08 | 1.48 |
| 8/11/73 | 8 | 3.10 | 171.44 | 2.50 | 0.38 | 2.55 |
| 8/11/73 | 14 | 5.10 | 166.30 | 3.00 | 0.72 | 2.95 |
| 8/11/73 | 20 | 6.40 | 177.09 | 2.20 | 0.11 | 2.23 |

# APPENDIX II. FOURIER COMPONENTS

Tables of the first 22 Fourier components or harmonics based on 1080 observations for weather data, 180 observations for wave data and 84 observations for current data. For each Fourier component, the period is in hours, amplitude in units of the observed data, phase in degrees and hours. Eighteen components were computed for the current observations which covered 36 days.

VARIABLE - Barometric Pressure

MEAN = 1018.341 MINIMUN = 1013.100 MAXIMIN = 1026.200

TOTAL SUM OF SQUARES = 9008.51

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .198 | 354.541 | 1063.624 | .277 |
| H 2 | 540.000 | 1.332 | 11.986 | 17.979 | 10.535 |
| H 3 | 360.000 | 1.171 | 250.181 | 250.181 | 8.737 |
| H 4 | 270.000 | 1.843 | 113.938 | 85.453 | 19.652 |
| H 5 | 216.000 | .979 | 308.694 | 185.217 | 6.246 |
| H 6 | 180.000 | 1.745 | 341.647 | 170.823 | 18.371 |
| H 7 | 154.286 | .714 | 222.387 | 95.309 | 3.366 |
| H 8 | 135.000 | .286 | 313.995 | 117.748 | .543 |
| H 9 | 120.000 | 1.274 | 133.478 | 44.493 | 9.575 |
| H10 | 108.000 | .377 | 208.427 | 62.528 | .991 |
| H11 | 98.182 | .950 | 170.511 | 46.503 | 5.419 |
| H12 | 90.000 | .693 | 167.773 | 41.943 | 2.782 |
| H13 | 83.077 | .721 | 126.815 | 29.265 | 2.817 |
| H14 | 77.143 | .163 | 242.564 | 51.978 | .248 |
| H15 | 72.000 | .269 | 211.841 | 42.368 | .480 |
| H16 | 67.500 | .053 | 264.657 | 49.623 | .064 |
| H17 | 63.529 | .112 | 57.685 | 10.180 | .085 |
| H18 | 60.000 | .219 | 68.781 | 11.463 | .252 |
| H19 | 56.842 | .330 | 349.029 | 55.110 | .726 |
| H20 | 54.000 | .137 | 296.531 | 44.480 | .183 |
| H21 | 51.429 | .477 | 213.047 | 30.435 | 1.445 |
| H22 | 49.091 | .449 | 130.978 | 17.861 | 1.123 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 93.19

VARIABLE - Air Temperature

MEAN = 57.381 MINIMUN = 46.000 MAXIMIN = 72.000

TOTAL SUM OF SQUARES = 25442.59

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .718 | 342.019 | 1026.058 | 1.345 |
| H 2 | 540.000 | .466 | 15.839 | 23.759 | .568 |
| H 3 | 360.000 | 1.540 | 268.681 | 268.681 | 5.793 |
| H 4 | 270.000 | .752 | 13.585 | 10.189 | 1.287 |
| H 5 | 216.000 | .916 | 137.987 | 82.792 | 1.725 |
| H 6 | 180.000 | .539 | 265.403 | 132.702 | .934 |
| H 7 | 154.286 | .370 | 18.749 | 8.035 | .400 |
| H 8 | 135.000 | .572 | 237.351 | 89.007 | 1.056 |
| H 9 | 120.000 | .337 | 182.038 | 60.679 | .411 |
| H10 | 108.000 | .460 | 182.534 | 54.760 | .615 |
| H11 | 98.182 | .728 | 113.235 | 30.882 | .993 |
| H12 | 90.000 | .325 | 275.640 | 68.910 | .529 |
| H13 | 83.077 | .529 | 181.420 | 41.866 | .746 |
| H14 | 77.143 | .149 | 196.626 | 42.134 | .216 |
| H15 | 72.000 | .366 | 91.239 | 18.248 | .291 |
| H16 | 67.500 | .282 | 237.727 | 44.574 | .420 |
| H17 | 63.529 | .343 | 14.776 | 2.608 | .395 |
| H18 | 60.000 | .241 | 47.958 | 7.993 | .218 |
| H19 | 56.842 | .313 | 50.194 | 7.925 | .275 |
| H20 | 54.000 | .405 | 66.641 | 9.996 | .348 |
| H21 | 51.429 | .177 | 151.457 | 21.637 | .198 |
| H22 | 49.091 | .118 | 357.690 | 48.776 | .193 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 15.48

VARIABLE - Wind Speed

MEAN = 7.969 MINIMUN = 0 MAXIMIN = 30.000

TOTAL SUM OF SQUARES = 40753.87

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | 1.603 | 227.127 | 681.382 | 3.513 |
| H 2 | 540.000 | 3.202 | 298.344 | 447.516 | 13.623 |
| H 3 | 360.000 | 3.172 | 145.420 | 145.420 | 13.542 |
| H 4 | 270.000 | 2.417 | 95.546 | 71.660 | 7.814 |
| H 5 | 216.000 | .214 | 283.237 | 169.942 | .156 |
| H 6 | 180.000 | 1.246 | 242.793 | 121.396 | 2.193 |
| H 7 | 154.286 | 1.502 | 122.137 | 52.345 | 3.093 |
| H 8 | 135.000 | .429 | 22.921 | 8.595 | .341 |
| H 9 | 120.000 | .826 | 41.736 | 13.912 | .936 |
| H10 | 108.000 | .362 | 41.155 | 12.347 | .250 |
| H11 | 98.182 | .672 | 92.704 | 25.283 | .674 |
| H12 | 90.000 | 1.092 | 124.509 | 31.127 | 1.628 |
| H13 | 83.077 | .960 | 40.177 | 9.272 | 1.240 |
| H14 | 77.143 | .313 | 213.949 | 45.846 | .246 |
| H15 | 72.000 | .502 | 142.459 | 28.492 | .423 |
| H16 | 67.500 | 1.508 | 111.016 | 20.816 | 2.940 |
| H17 | 63.529 | .531 | 236.444 | 41.725 | .520 |
| H18 | 60.000 | .434 | 325.818 | 54.303 | .353 |
| H19 | 56.842 | .726 | 184.122 | 29.072 | .791 |
| H20 | 54.000 | .422 | 10.689 | 1.603 | .323 |
| H21 | 51.429 | .487 | 99.734 | 14.248 | .370 |
| H22 | 49.091 | .089 | 164.870 | 22.482 | .039 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 52.93

VARIABLE - Onshore Wind

MEAN = 1.255 MINIMUN = -6.973 MAXIMIN = 9.959

TOTAL SUM OF SQUARES = 5014.43

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .091 | 13.005 | 39.015 | .130 |
| H 2 | 540.000 | .145 | 220.400 | 330.600 | .326 |
| H 3 | 360.000 | .418 | 58.251 | 58.251 | 1.935 |
| H 4 | 270.000 | .406 | 260.488 | 195.366 | 1.856 |
| H 5 | 216.000 | .052 | 258.076 | 154.846 | .128 |
| H 6 | 180.000 | .285 | 202.355 | 101.177 | .951 |
| H 7 | 154.286 | .184 | 67.844 | 29.076 | .432 |
| H 8 | 135.000 | .176 | 239.167 | 89.687 | .439 |
| H 9 | 120.000 | .152 | 227.433 | 75.811 | .350 |
| H10 | 108.000 | .171 | 229.590 | 68.877 | .414 |
| H11 | 98.182 | .131 | 62.369 | 17.010 | .292 |
| H12 | 90.000 | .130 | 5.552 | 1.388 | .236 |
| H13 | 83.077 | .141 | 330.848 | 76.349 | .314 |
| H14 | 77.143 | .102 | 219.657 | 47.069 | .213 |
| H15 | 72.000 | .273 | 43.373 | 8.675 | .838 |
| H16 | 67.500 | .143 | 353.544 | 66.289 | .239 |
| H17 | 63.529 | .119 | 197.398 | 34.835 | .274 |
| H18 | 60.000 | .107 | 207.947 | 34.658 | .234 |
| H19 | 56.842 | .103 | 173.905 | 27.459 | .218 |
| H20 | 54.000 | .160 | 56.001 | 8.400 | .358 |
| H21 | 51.429 | .086 | 332.073 | 47.439 | .176 |
| H22 | 49.091 | .173 | 246.989 | 33.680 | .451 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 8.96

VARIABLE - Alongshore Wind

MEAN = 5.858 MINIMUN = -11.276 MAXIMIN = 28.978

TOTAL SUM OF SQUARES = 65909.87

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | 3.097 | 211.803 | 635.408 | 7.904 |
| H 2 | 540.000 | 4.224 | 294.293 | 441.439 | 14.593 |
| H 3 | 360.000 | 4.514 | 149.185 | 149.185 | 16.819 |
| H 4 | 270.000 | 3.806 | 73.514 | 55.136 | 11.922 |
| H 5 | 216.000 | 1.117 | 318.968 | 191.381 | 1.062 |
| H 6 | 180.000 | .997 | 267.596 | 133.798 | .834 |
| H 7 | 154.286 | .784 | 118.006 | 50.574 | .550 |
| H 8 | 135.000 | .313 | 102.159 | 38.309 | .113 |
| H 9 | 120.000 | 1.469 | 65.885 | 21.962 | 1.813 |
| H10 | 108.000 | 1.125 | 82.450 | 24.735 | 1.057 |
| H11 | 98.182 | 1.693 | 83.135 | 22.673 | 2.326 |
| H12 | 90.000 | 1.523 | 112.589 | 28.147 | 1.859 |
| H13 | 83.077 | 1.027 | 64.977 | 14.995 | .798 |
| H14 | 77.143 | .780 | 167.474 | 35.887 | .545 |
| H15 | 72.000 | .940 | 160.195 | 32.039 | .747 |
| H16 | 67.500 | 1.918 | 120.483 | 22.591 | 2.836 |
| H17 | 63.529 | .920 | 257.509 | 45.443 | .836 |
| H18 | 60.000 | .822 | 262.549 | 43.758 | .638 |
| H19 | 56.842 | 1.026 | 199.294 | 31.467 | .833 |
| H20 | 54.000 | .140 | 252.655 | 37.898 | .043 |
| H21 | 51.429 | .732 | 104.718 | 14.960 | .422 |
| H22 | 49.091 | .285 | 359.411 | 49.011 | .104 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 67.97

VARIABLE - Significant Wave Height

MEAN = 2.797 MINIMUN = 1.200 MAXIMIN = 6.500

TOTAL SUM OF SQUARES = 220.31

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .732 | 11.846 | 35.539 | 21.602 |
| H 2 | 540.000 | .830 | 218.984 | 328.476 | 29.109 |
| H 3 | 360.000 | .459 | 140.707 | 140.707 | 8.099 |
| H 4 | 270.000 | .317 | 352.992 | 264.744 | 4.157 |
| H 5 | 216.000 | .354 | 161.800 | 97.080 | 4.915 |
| H 6 | 180.000 | .213 | 120.866 | 60.433 | 1.527 |
| H 7 | 154.286 | .105 | 147.052 | 63.022 | .344 |
| H 8 | 135.000 | .051 | 338.504 | 126.939 | .142 |
| H 9 | 120.000 | .239 | 347.352 | 115.784 | 2.437 |
| H10 | 108.000 | .102 | 228.284 | 68.485 | .562 |
| H11 | 98.182 | .311 | 122.901 | 33.518 | 3.496 |
| H12 | 90.000 | .293 | 110.111 | 27.528 | 3.018 |
| H13 | 83.077 | .111 | 265.683 | 61.312 | .707 |
| H14 | 77.143 | .038 | 181.129 | 38.813 | .060 |
| H15 | 72.000 | .072 | 18.739 | 3.748 | .158 |
| H16 | 67.500 | .134 | 109.709 | 20.570 | .507 |
| H17 | 63.529 | .219 | 124.608 | 21.990 | 1.638 |
| H18 | 60.000 | .123 | 24.458 | 4.076 | .523 |
| H19 | 56.842 | .034 | 238.568 | 37.669 | .110 |
| H20 | 54.000 | .107 | 162.300 | 24.345 | .412 |
| H21 | 51.429 | .187 | 53.787 | 7.684 | 1.152 |
| H22 | 49.091 | .134 | 42.563 | 5.804 | .571 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 84.75

VARIABLE - Breaker Height

MEAN = 3.556 MINIMUN = 1.500 MAXIMIN = 8.200

TOTAL SUM OF SQUARES = 342.72

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .889 | 12.427 | 37.282 | 20.499 |
| H 2 | 540.000 | 1.027 | 217.579 | 326.369 | 28.640 |
| H 3 | 360.000 | .588 | 141.161 | 141.161 | 8.523 |
| H 4 | 270.000 | .395 | 354.274 | 265.705 | 4.147 |
| H 5 | 216.000 | .431 | 162.590 | 97.554 | 4.636 |
| H 6 | 180.000 | .262 | 119.815 | 59.907 | 1.459 |
| H 7 | 154.286 | .142 | 150.085 | 64.322 | .426 |
| H 8 | 135.000 | .049 | 335.883 | 125.956 | .033 |
| H 9 | 120.000 | .314 | 348.895 | 116.298 | 2.676 |
| H10 | 108.000 | .125 | 229.449 | 68.835 | .533 |
| H11 | 98.182 | .396 | 120.175 | 32.775 | 3.611 |
| H12 | 90.000 | .370 | 111.735 | 27.934 | 3.034 |
| H13 | 83.077 | .162 | 263.692 | 60.852 | .923 |
| H14 | 77.143 | .057 | 178.307 | 38.209 | .084 |
| H15 | 72.000 | .101 | 26.103 | 5.221 | .200 |
| H16 | 67.500 | .183 | 106.109 | 19.896 | .622 |
| H17 | 63.529 | .273 | 125.252 | 22.103 | 1.630 |
| H18 | 60.000 | .143 | 23.426 | 3.904 | .454 |
| H19 | 56.842 | .036 | 227.937 | 35.990 | .073 |
| H20 | 54.000 | .130 | 153.203 | 22.980 | .358 |
| H21 | 51.429 | .250 | 51.814 | 7.402 | 1.351 |
| H22 | 49.091 | .164 | 43.472 | 5.928 | .537 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 84.02

VARIABLE - Wave Period

MEAN = 7.382 MINIMUN = 5.240 MAXIMIN = 9.000

TOTAL SUM OF SQUARES = 143.21

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .577 | 32.125 | 96.376 | 19.328 |
| H 2 | 540.000 | .554 | 163.531 | 245.296 | 18.451 |
| H 3 | 360.000 | .236 | 258.034 | 258.034 | 4.703 |
| H 4 | 270.000 | .096 | 6.289 | 4.717 | .527 |
| H 5 | 216.000 | .311 | 176.830 | 106.098 | 5.972 |
| H 6 | 180.000 | .210 | 84.596 | 42.298 | 1.633 |
| H 7 | 154.286 | .202 | 224.807 | 96.346 | 3.315 |
| H 8 | 135.000 | .188 | 11.386 | 4.270 | 2.029 |
| H 9 | 120.000 | .176 | 244.994 | 81.665 | 2.771 |
| H10 | 108.000 | .086 | 87.160 | 26.148 | .019 |
| H11 | 98.182 | .206 | 101.025 | 27.552 | 1.612 |
| H12 | 90.000 | .180 | 124.188 | 31.047 | 1.273 |
| H13 | 83.077 | .109 | 229.774 | 53.025 | 1.172 |
| H14 | 77.143 | .186 | 199.283 | 42.703 | 2.506 |
| H15 | 72.000 | .164 | 90.642 | 18.128 | .835 |
| H16 | 67.500 | .081 | 179.063 | 33.574 | .409 |
| H17 | 63.529 | .102 | 82.989 | 14.645 | .129 |
| H18 | 60.000 | .043 | 203.922 | 33.987 | .208 |
| H19 | 56.842 | .117 | 21.703 | 3.427 | .636 |
| H20 | 54.000 | .150 | 146.784 | 22.018 | .933 |
| H21 | 51.429 | .178 | 50.648 | 7.235 | 1.282 |
| H22 | 49.091 | .035 | 95.298 | 12.995 | -0.104 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 67.61

VARIABLE - Wave Steepness

MEAN = .046 MINIMUN = .020 MAXIMIN = .100

TOTAL SUM OF SQUARES = .05

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | .010 | 9.696 | 29.087 | 18.418 |
| H 2 | 540.000 | .012 | 222.377 | 333.566 | 28.532 |
| H 3 | 360.000 | .008 | 139.127 | 139.127 | 10.838 |
| H 4 | 270.000 | .005 | 355.025 | 266.269 | 4.073 |
| H 5 | 216.000 | .005 | 159.188 | 95.513 | 4.138 |
| H 6 | 180.000 | .003 | 123.162 | 61.581 | 1.259 |
| H 7 | 154.286 | .002 | 135.567 | 58.100 | .530 |
| H 8 | 135.000 | .000 | 0 | 0 | .006 |
| H 9 | 120.000 | .004 | 355.659 | 118.553 | 3.258 |
| H10 | 108.000 | .002 | 226.826 | 68.048 | .657 |
| H11 | 98.182 | .005 | 121.746 | 33.203 | 3.416 |
| H12 | 90.000 | .004 | 111.194 | 27.798 | 3.136 |
| H13 | 83.077 | .002 | 270.000 | 62.308 | .771 |
| H14 | 77.143 | -0.000 | 0 | 0 | .014 |
| H15 | 72.000 | .001 | 12.293 | 2.459 | .138 |
| H16 | 67.500 | .002 | 90.000 | 16.875 | .737 |
| H17 | 63.529 | .003 | 125.571 | 22.160 | 1.735 |
| H18 | 60.000 | .002 | 24.102 | 4.017 | .603 |
| H19 | 56.842 | -0.001 | 0 | 0 | .060 |
| H20 | 54.000 | .001 | 152.386 | 22.858 | .273 |
| H21 | 51.429 | .003 | 52.940 | 7.563 | 1.306 |
| H22 | 49.091 | .002 | 42.994 | 5.863 | .627 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 83.95

VARIABLE - Wave Energy

MEAN = 3556.727 MINIMUN = 377.057 MAXIMIN = 19203.134

TOTAL SUM OF SQUARES =030684982.4*

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 1080.000 | 2117.103 | 4.192 | 12.575 | 19.821 |
| H 2 | 540.000 | 2380.052 | 214.389 | 321.583 | 25.437 |
| H 3 | 360.000 | 1218.334 | 130.936 | 130.936 | 6.317 |
| H 4 | 270.000 | 1029.969 | 342.265 | 256.699 | 4.791 |
| H 5 | 216.000 | 1012.468 | 176.209 | 105.725 | 4.524 |
| H 6 | 180.000 | 805.794 | 105.950 | 52.975 | 2.658 |
| H 7 | 154.286 | 230.994 | 222.915 | 95.535 | .281 |
| H 8 | 135.000 | 149.782 | 292.609 | 109.728 | .139 |
| H 9 | 120.000 | 749.080 | 340.833 | 113.611 | 2.557 |
| H10 | 108.000 | 304.927 | 250.252 | 75.076 | .494 |
| H11 | 98.182 | 1022.865 | 120.509 | 32.866 | 4.387 |
| H12 | 90.000 | 690.388 | 94.212 | 23.553 | 1.917 |
| H13 | 83.077 | 600.229 | 255.837 | 59.039 | 1.732 |
| H14 | 77.143 | 446.889 | 191.272 | 40.987 | .910 |
| H15 | 72.000 | 401.325 | 34.402 | 6.880 | .649 |
| H16 | 67.500 | 83.605 | 171.404 | 32.138 | .027 |
| H17 | 63.529 | 661.898 | 132.330 | 23.352 | 1.803 |
| H18 | 60.000 | 322.318 | 29.582 | 4.930 | .415 |
| H19 | 56.842 | 408.788 | 276.463 | 43.652 | .856 |
| H20 | 54.000 | 370.626 | 169.005 | 25.351 | .589 |
| H21 | 51.429 | 567.954 | 49.724 | 7.103 | 1.306 |
| H22 | 49.091 | 277.463 | 24.379 | 3.324 | .309 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 82.02

VARIABLE . LITTORAL CURRENT

MEAN = 1.147 MINIMUN = .090 MAXIMIN = 3.140

TOTAL SUM OF SQUARES = 27.55

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 864.000 | .366 | 137.862 | 330.870 | 13.661 |
| H 2 | 432.000 | .048 | 220.301 | 264.361 | .538 |
| H 3 | 288.000 | .400 | 120.754 | 96.603 | 16.617 |
| H 4 | 216.000 | .362 | 124.634 | 74.780 | 9.332 |
| H 5 | 172.800 | .371 | 158.731 | 76.191 | 4.625 |
| H 6 | 144.000 | .212 | 178.507 | 71.403 | -0.869 |
| H 7 | 123.429 | .112 | 42.962 | 14.730 | -2.243 |
| H 8 | 108.000 | .167 | 177.597 | 53.279 | 1.736 |
| H 9 | 96.000 | .314 | 219.098 | 58.426 | .117 |
| H10 | 86.400 | .163 | 42.376 | 10.170 | -6.018 |
| H11 | 78.545 | .092 | 110.670 | 24.146 | -2.370 |
| H12 | 72.000 | .123 | 187.732 | 37.546 | 1.934 |
| H13 | 66.462 | .123 | 132.681 | 24.495 | -0.216 |
| H14 | 61.714 | .058 | 183.611 | 31.476 | -0.050 |
| H15 | 57.600 | .089 | 204.001 | 32.640 | -1.297 |
| H16 | 54.000 | .079 | 303.981 | 45.597 | .030 |
| H17 | 50.823 | .143 | 131.836 | 18.612 | -2.807 |
| H18 | 48.000 | .067 | 146.010 | 19.468 | -2.239 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 34.78

VARIABLE ONSHORE LITTORAL COMPONENT

MEAN = .078 MINIMUN = -0.830 MAXIMIN = .910

TOTAL SUM OF SQUARES = 11.49

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 864.000 | .058 | 42.610 | 102.264 | .980 |
| H 2 | 432.000 | .034 | 131.402 | 157.683 | .216 |
| H 3 | 288.000 | .093 | 30.869 | 24.695 | 3.433 |
| H 4 | 216.000 | .066 | 71.975 | 43.185 | 1.422 |
| H 5 | 172.800 | .079 | 195.104 | 93.650 | 1.922 |
| H 6 | 144.000 | .066 | 232.085 | 92.834 | 1.483 |
| H 7 | 123.429 | .029 | 21.352 | 7.321 | .262 |
| H 8 | 108.000 | .117 | 204.347 | 61.304 | 4.573 |
| H 9 | 96.000 | .093 | 288.812 | 77.017 | 3.739 |
| H10 | 86.400 | .118 | 160.310 | 38.474 | 5.078 |
| H11 | 78.545 | .054 | 246.823 | 53.852 | 1.250 |
| H12 | 72.000 | .062 | 245.165 | 49.033 | 1.679 |
| H13 | 66.462 | .130 | 140.031 | 25.852 | 5.843 |
| H14 | 61.714 | .081 | 333.037 | 57.092 | 3.347 |
| H15 | 57.600 | .074 | 158.265 | 25.322 | 1.536 |
| H16 | 54.000 | .087 | 181.896 | 27.284 | 2.452 |
| H17 | 50.823 | .114 | 47.493 | 6.705 | 6.000 |
| H18 | 48.000 | .036 | 251.403 | 33.520 | .399 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 43.31

VARIABLE ALCNGSHORE LITTORAL COMPONENT

MEAN = .815 MINIMUN = -1.710 MAXIMIN = 3.090

TOTAL SUM OF SQUARES = 72.30

| COMPONENT | PERIOD | AMPLITUDE | PHASE | PHASE IN HOURS | PERCENTAGE SUM OF SQUARES |
|---|---|---|---|---|---|
| H 1 | 864.000 | .622 | 138.693 | 332.863 | 18.610 |
| H 2 | 432.000 | .361 | 286.340 | 343.608 | 11.964 |
| H 3 | 288.000 | .579 | 152.374 | 121.899 | 15.544 |
| H 4 | 216.000 | .369 | 126.458 | 75.875 | 3.774 |
| H 5 | 172.800 | .511 | 177.556 | 85.227 | 10.452 |
| H 6 | 144.000 | .387 | 170.778 | 68.311 | 4.704 |
| H 7 | 123.429 | .138 | 63.489 | 21.768 | -0.638 |
| H 8 | 108.000 | .346 | 180.935 | 54.280 | 5.263 |
| H 9 | 96.000 | .256 | 189.282 | 50.475 | -0.022 |
| H10 | 86.400 | .130 | 64.208 | 15.410 | -1.655 |
| H11 | 78.545 | .179 | 101.757 | 22.202 | -0.522 |
| H12 | 72.000 | .171 | 174.456 | 34.891 | .842 |
| H13 | 66.462 | .181 | 108.466 | 20.024 | .601 |
| H14 | 61.714 | .094 | 155.524 | 26.661 | -0.212 |
| H15 | 57.600 | .046 | 281.525 | 45.044 | .211 |
| H16 | 54.000 | .013 | 152.927 | 22.939 | .002 |
| H17 | 50.823 | .074 | 50.984 | 7.198 | .310 |
| H18 | 48.000 | .178 | 163.558 | 21.808 | -1.335 |

PERCENT SUM OF SQUARES ACCOUNTED FOR BY CUMMULATIVE CURVE = 68.92

Office of Naval Research
Geography Programs
Code 462
Washington, D.C. 22217

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

Director, Naval Research Laboratory
Attention Technical Information Officer
Washington, D.C. 20390

Director
Office of Naval Research Branch Office
1030 East Green Street
Pasadena, California 91101

Director
Office of Naval Research Branch Office
219 South Dearborn Street
Chicago, Illinois 60604

Director
Office of Naval Research Branch Office
495 Summer Street
Boston, Massachusetts 02210

Director, Naval Research Laboratory
Attention Library, Code 2029 (ONRL)
Washington, D.C. 20390

Chief of Naval Research
Asst. for Marine Corps Matters
Code 111
Office of Naval Research
Washington, D.C. 22217

Chief of Naval Research
Ocean Science and Technology Group
Code 480
Office of Naval Research
Washington, D.C. 22217

Chief of Naval Operations
OP098T
Department of the Navy
Washington, D.C. 20350

Commanding General
Marine Corps Development and
Educational Command
Quantico, Virginia 22134

Dr. A.L. Slafkosky
Scientific Advisor
Commandant of the Marine Corps (Code AX)
Washington, D.C. 20380

Oceanographer of the Navy
Hoffman 11 Building
200 Stovall Street
Alexandria, Virginia 22332

Librarian
Naval Intelligence
Support Center
4301 Suitland Road
Washington, D.C. 20390

Commander
Naval Facilities Engineering Command
Engineering & Design
Washington, D.C. 20390

President, Naval War College
Newport, Rhode Island 02840

Commanding Officer
Naval Civil Engineering Laboratory
Port Hueneme, California 93041

Director
Defense Mapping Topographic Center
Attention Code 50200
Washington, D.C. 20315

Director
Coastal Engineering Research Center
U.S. Army Corps of Engineers
Kingman Building
Fort Belvoir, Virginia 22060

Central Intelligence Agency
Attention OCR/DD-Publications
Washington, D.C. 20505

Commandant
U.S. Coast Guard
Attention GECV/61
Washington, D.C. 20591

Dr. Carl O. Sauer
Department of Geography
University of California
Berkeley, California 94720

Assistant Director for Research and Development
National Ocean Survey
6001 Executive Boulevard
Rockville, Maryland 20852

Dr. Donn S. Gorsline
Department of Geology
University of Southern California
Los Angeles, California 90007

National Oceanographic Data Center D764
Environmental Data Services
NOAA
Washington, D.C. 20235

Dr. Robert L. Miller
Department of Geophysical Sciences
University of Chicago
Chicago, Illinois 60637

Naval Academy Library
U.S. Naval Academy
Annapolis, Maryland 21402

Commander
Naval Oceanographic Office
Attention Library Code 36
Washington, D.C. 20374

Naval Ordnance Laboratory
White Oak
Silver Spring, Maryland 20910

Dr. Douglas L. Inman
Scripps Institute of Oceanography
La Jolla, California 92037

Division of Land Research
Commonwealth Scientific and Industrial Research Organization
P.O. Box 109
Canberra City, A.C.T., Australia

Library
American Geographical Society
Broadway at 156th Street
New York, New York 10032

Dr. William W. Wood
Department of Geosciences
Purdue University
Lafayette, Indiana 47907

Defense Intelligence Agency
DIAAP-10A
Washington, D.C. 20301

Dr. Bernard Le Mehaute
Tetra Tech, Inc.
630 North Rosemead Blvd.
Pasadena, California 91107

Dr. Richard A. Davis, Jr.
Department of Geology
University of South Florida
Tampa, Florida 33620

Dr. William T. Fox
Department of Geology
Williams College
Williamstown, Mass. 01267

Dr. William S. Gaither
Dean, College of Marine Studies
Robinson Hall
University of Delaward
Neward, Delaware 19711

Naval Oceanographic Office
Code 01
Washington, D.C. 20390

Naval Oceanographic Office
Code 92
Washington, D.C. 20374

Office of Naval Research
Operational Applications Division
Code 410
Arlington, Virginia 22217

Officer in Charge
Environmental Prediction
Research Facility
Naval Post Graduate School
Monterey, California 93940

National Lending Library
for Science and Technology
Boston SPA
Yorkshire LS23 7BQ
Great Britain

Physical and Ocean Sciences Department
U.S. Coast Guard Academy
New London, Connecticut 06320

Office of Research and Development
DS/62
U.S. Coast Guard
Washington, D.C. 20591

Commanding Officer
U.S. Army Engineering
Topographic Laboratory
Atten# ETL-ST
Fort Belvoir, Virginia 22060

Dr. J. A. Dracup
Environmental Dynamics, Inc.
1609 Westwood Boulevard, Suite 202
Los Angeles, California 90024

Dr. Thomas K. Peucker
Simon Fraser University
Department of Geography
Burnaby 2, B.C., Canada

Dr. John T. Kud
Henry Krumb School of Mines
Seeley W. Mudd Building
Columbia University
New York, New York 10027

Dr. Edward B. Thornton
Department of Oceanography
Naval Postgraduate School
Monterey, California 93940

Dr. Carl E. Youngmann
University of Washington
Department of Geography
Seattle, Washington 98105

Director
Amphibious Warfare Board
U.S. Atlantic Fleet
Naval Amphibious Base
Norfolk, Little Creek, Virginia 23520

Ministerialrat Prof. Dr. H. J. Aufm Kamp
Abteilung RU/FO III
Bundes Ministerium der Verteidigung
Postfach 161
D-5300 Bonn, West Germany

Dr. Gordon E. Carlson
University of Missouri
Department of Electrical Engineering
Rolla, Missouri 65401

Library
Faculty of Law
Dalhousie University
Halifax, Nova Scotia, Canada

Commander, Amphibious Force
U.S. Pacific Fleet
Force Meteorologist
Comphibpac Code 25 5
San Diego, California 92155

Dr. Lester A. Gerhardi
Rennsselaer Polytechnic Institute
Troy, New York 12181

Dr. Robert Vincent
Environmental Research Institute
P.O. Box 618
Ann Arbor, Michigan 48107

Dr. Dale F. Leipper
Department of Oceanography
Naval Postgraduate School
Monterey, California 93940

Establissement
Principal Du Service
Hydrographique Et
Oceanographique De
La Marine
29 283 Brest - Cedex

Unit of Coastal Sedimentation
Beadom Road, Taunton
Somerset, England

The Library
Department of Geography
University of Cambridge
Downing Place
Cambridge, England

The Library
Royal Geographical Society
Kensington Grove
London, S. W. 1
England

Coastal Studies Institute
Louisiana State University
Baton Rouge Louisiana 70803

Dr. Warren C. Thompson
Dept. of Meteorology & Oceanography
U. S. Naval Postgraduate School
Monterey, California 93940

Dr. Horace G. Richards
Dept. of Geology and Paleontology
Academy of Natural Sciences
19th Street and Parkway
Philadelphia, Pennsylvania 19103

Commanding Officer
Naval Coastal Systems Laboratory
Panama City, Florida 32401

Office of Naval Research
Scientific Liaison Officer
Scripps Institution of Oceanography
La Jolla, California 92038

Commanding Officer
Naval Air Development Center
Warminster, Johnsville
Pennsylvania 18974

Unclassified

Security Classification

## DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

| | |
|---|---|
| 1. ORIGINATING ACTIVITY (Corporate author)<br>Williams College<br>Williamstown, Massachusetts | 2a. REPORT SECURITY CLASSIFICATION<br>Unclassified<br>2b. GROUP |

3. REPORT TITLE

Beach Processes on the Oregon Coast, July, 1973

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report No. 12

5. AUTHOR(S) (First name, middle initial, last name)

William T. Fox
Richard A. Davis, Jr.

| 6. REPORT DATE | 7a. TOTAL NO. OF PAGES | 7b. NO. OF REFS |
|---|---|---|
| August 30, 1974 | 85 | 28 |

| | |
|---|---|
| 8a. CONTRACT OR GRANT NO.<br>N00014-69-C-0151<br>b. PROJECT NO.<br>NR 388-092<br>c.<br>d. | 9a. ORIGINATOR'S REPORT NUMBER(S)<br>WC-12<br>9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

| | |
|---|---|
| 11. SUPPLEMENTARY NOTES | 12. SPONSORING MILITARY ACTIVITY<br>Geography Programs - Code 462<br>Office of Naval Research<br>Arlington, Virginia 22217 |


13. ABSTRACT

During July and August, 1973, a 45-day time-series study was undertaken on the central Oregon coast to relate weather and wave conditions to beach erosion and sand bar migration. The summer weather pattern was dominated by the East-Pacific subtropical high which produced winds and waves from the northwest and extended periods of upwelling and coastal fog. When low pressure systems moved through, wind and waves shifted to the southwest. Waves were 1 to 3 meters high with periods of 5 to 9 seconds. Rip currents and southward flowing longshore currents reached 90 centimeters/second in the surf zone. Tide range was 2 to 4 meters.

Three beaches were mapped at low tide to show changes in beach and bar morphology through time. At South Beach, Oregon two sets of bars with intervening rip channels advanced shoreward at 1 to 5 meters/day and southward at 10 to 15 meters/day. At Beverly Beach, Oregon, a basalt ridge 700 meters offshore resulted in wave diffraction and sand deposition in the central portion of the beach. A rip channel at the south end of the beach moved 300 meters to the south. At Gleneden Beach, cusps 40 meters long were cut into the steep foreshore. A rhythmic topography with bars and rip channels existed in the nearshore. Sand bars advanced across the rip channels at 5 meters/day and welded onto the base of the foreshore.

Unclassified
Security Classification

| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Fourier Analysis | | | | | | |
| Oregon Coast | | | | | | |
| Weather data | | | | | | |
| Wave data | | | | | | |
| Longshore currents | | | | | | |
| Rip currents | | | | | | |
| Sand bars | | | | | | |
| Beach erosion | | | | | | |
| Beach cusps | | | | | | |

DD FORM 1 NOV 65 1473 (BACK)
(PAGE 2)

Unclassified
Security Classification